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BEST UTILITIES

The Ultimate Software Shelf: PC Magazine Editors Pick 33 Must-Have Utilities

SOFTWARE

Beyond Mailing Lists: PC Labs Tests 6 Flat-File Databases

CONNECTIVITY

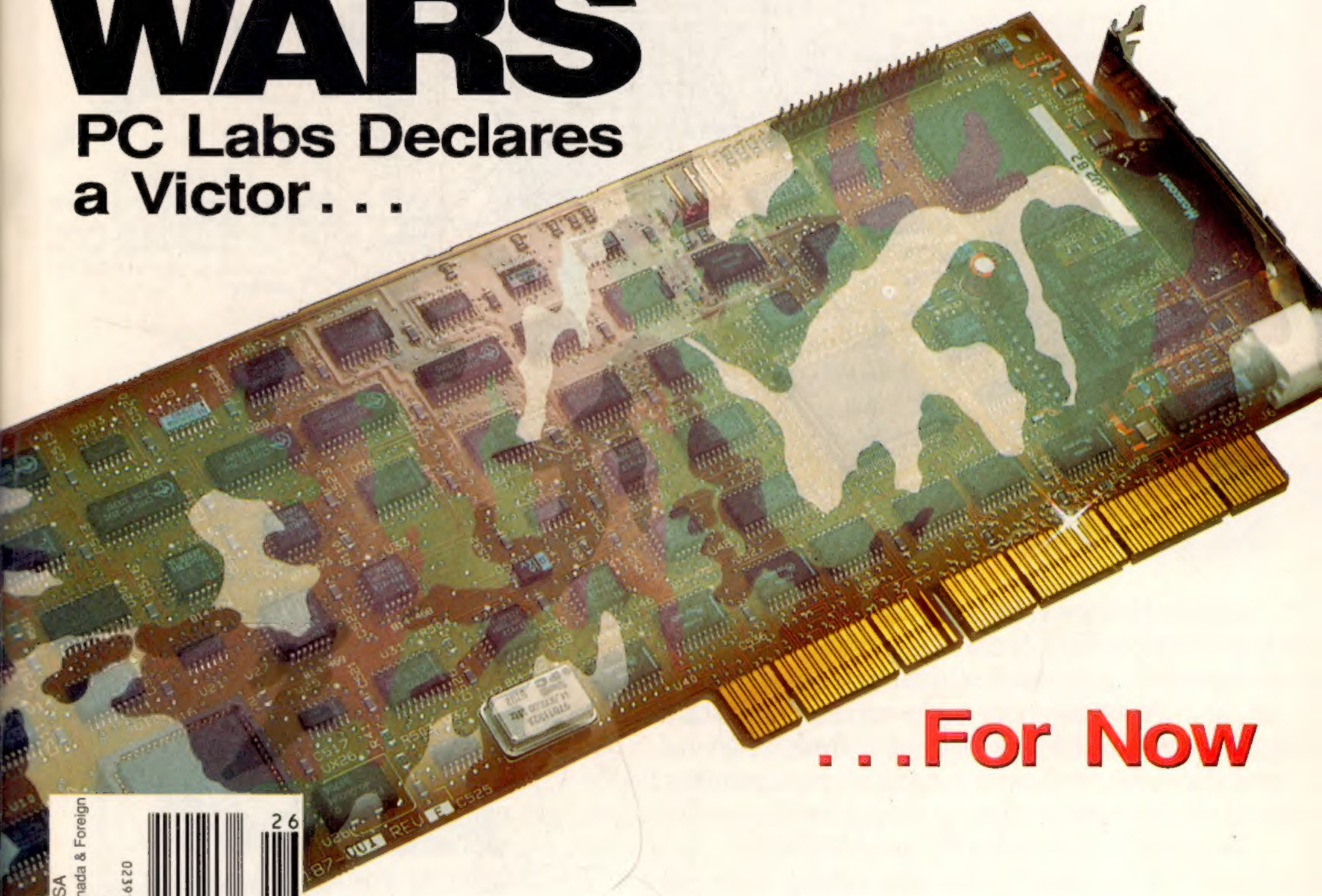
LAN Analyzers From \$300 to \$20,000 Save Your Network And Your Job

FREE UTILITY

Try Michael Mefford's Great New Disk-Management Utility, PRUNE

JUNE 26, 1990 THE INDEPENDENT GUIDE TO IBM-STANDARD PERSONAL COMPUTING VOLUME 9 NUMBER 12

EISA vs. ISA vs. Micro Channel
BUS WARS
PC Labs Declares a Victor...



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26

Word
processing will
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in the next three
pages than it
has in the last
ten years.

Market Survey and Ten Year Growth Plan

EXECUTIVE SUMMARY

BLUE YONDER AIRWAY



Introduction

As Blue Yonder Airways moves from freight to passenger service, the Sales and Marketing Division is presented with a multitude of new challenges and opportunities. This report consists of a marketing proposal for the next ten years -- a virtual blueprint for growth in our critical first decade as a passenger carrier. Our

resulting from a series of focus groups conducted by the market research firm Crump & Graham. The growth plan includes specific suggestions for ways to leverage our track record in the freight arena to build out our share of single-passenger bookings, and ultimately expand into general sales. A detailed analysis of costs and

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The ALR BusinessVEISA				
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Speed	33-MHz	33-MHz	25-MHz	25-MHz
Memory	1-MB	2-MB	2-MB	2-MB
Cache	64-KB	64-KB	Opt.	Opt.
Video	Opt.	SVGA*	Opt.	SVGA*
Monitor	Opt.	SVGA*	Opt.	SVGA*
Storage	0-MB	40-MB	0-MB	106-MB
Floppies	5.25	3.5", 5.25"	5.25"	3.5", 5.25"
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*Graphics adapter supports both standard VGA resolutions and 800x600 SuperVGA (SVGA) modes. Monitor automatically adjusts frequency to support both standard VGA and SVGA modes.

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If you want a system that can evolve to meet your future needs at a price that's nothing short of revolutionary, the ALR BusinessVEISA 386/33 was built for you. For more information, please call:

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Model	1	40	1	110
CPU	386	386	i486	i486
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33-MHz i486 CPU Module



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CIRCLE 280 ON READER SERVICE CARD

Inside

We knew when we decided to mediate the War of the Buses that it wasn't going to be a pretty sight. True, no furniture is being thrown around, but just about everything else is: insults, accusations, reputations. The task of sorting through the fracas to find the merits (and demerits) of EISA, ISA, and MCA fell to project leader Wendy Dugas Pérez, a network and PC specialist.

Pérez's challenge was to design a testing platform that would pit the architectures against each other fairly. The first task was to choose the actual machines to represent the three bus architectures.

"One thing we wanted to accomplish was to isolate the buses—to make the basic test machines as similar as possible," Pérez said. "Thus we chose the ALR PowerCache series for the three basic machines and went straight to the source—IBM, Compaq, and Everex—for top-of-the-line machines in the MCA, EISA, and ISA categories, respectively."

Once Pérez had made her hardware selections, she enlisted industry expert Ben Myers to write the actual tests. Myers, whose tests have graced the pages of *PC Magazine* before, is the founder of Spirit of Performance Inc., a consulting firm.

Pérez and Myers found that the immaturity of the EISA market presented the greatest hurdles to testing.



"The number of available add-in boards was severely limited, and although they were production models, many of them just weren't ready to hit the streets," said Pérez.

"Both the products and our testing setup changed during this review," Myers explained. As often happens when *PC Magazine* tests a new technology, companies involved in this story modified the configuration files of their add-in boards based on discoveries made by PC Labs.

The question remains: is there one "best" bus architecture?

Pérez says that buying decisions may be more a question of market maturity than bus superiority. "This review is part of an ongoing process to examine the merits of the three platforms,"

Pérez said. "In a way, we stopped time to isolate a best choice in the current market, but we look forward to seeing what kind of support develops in the industry for the newer architectures."

The best PC hardware deserves the smartest PC software. Executive editor Bill Howard and a dozen *PC Magazine* contributing editors duked it out and came up with the ultimate software shelf, a no-nonsense look at 33 utilities that no self-respecting power user can do without. Whether your debates are over hardware or software, buses or utilities, this is the issue to bring to the forum.

—Stephanie K. Losee



Project leader Wendy Dugas Pérez and Consultant Ben Myers dissected EISA, ISA, and MCA.

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"QMS-PS 810 buyers awarded it the top score in value relative to cost."
PC Week

MACWORLD

"(The QMS-PS 810) is much faster than the LaserWriter IINT... In all, it's a fine printer. A recent price cut... makes it the obvious choice over the LaserWriter IINTX."

Jim Heid - Macworld



"What sets this 300 dpi printer (QMS-PS 820) apart is speed. QMS has designed a printer controller that pushes PostScript and the Canon engine to the limits of their performance."

Electronic Publishing & Printing



"If you're looking for a laser printer with a PostScript language controller (and the famous 35 Adobe fonts built into ROM), take a look at QMS's superb PS 810."

Jim Seymour - PC Magazine



The QMS-PS 810



The QMS-PS 820

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*Bruce Brown, PC Magazine
Editor's Choice Review*

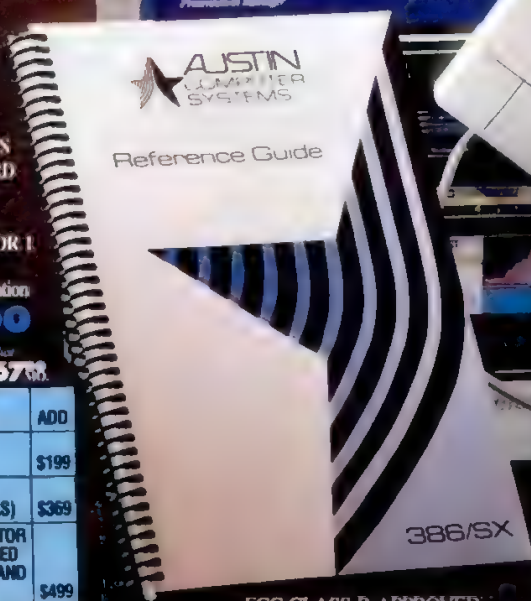
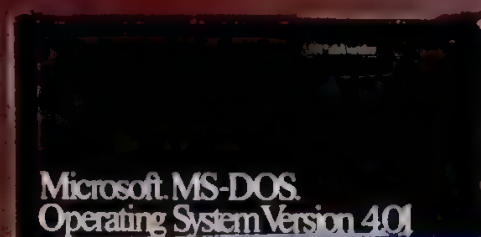
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ing. The 2MB RAM needed to run Windows is offered by other computer companies as an upgrade. On your Austin it is a standard feature.

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We load the software . . . test it, burn it in, and then send your system through our Quality Assurance Lab to make sure it's ready to run right out of the box.

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Unlike any other forms package, F3 Pro Designer provides the ability to efficiently design, analyze and manage pre-printed forms — still the backbone of corporate information flow. It provides a true first step toward total forms automation and a balance between paper and electronic forms.

F3 Pro Designer actually becomes an integral part of the manufacturing process. As you design a form, the system automatically creates separated mechanical art along with a comprehensive set of production specifications for each phase of production, including prep, printing, construction design and bindery. F3 Pro Designer will handle virtually any form type: desktop/laser, flat/cut sheet, flat/card mailer, continuous, unit set, mailer, heat seal, checks and more.

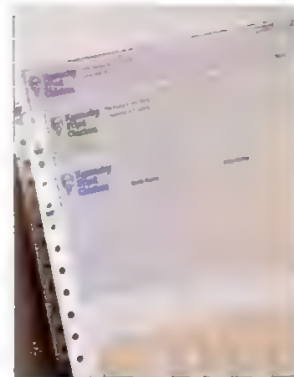
In fact, F3 Pro Designer is used as an in-house design tool by the industry's leading forms manufacturers.

No wonder everyone's talking about this remarkable new software system. Like Andy Brown, Director of Forms Management for Kentucky Fried Chicken Restaurants. "I've designed thousands of forms in my career, mostly by hand. Since I began using F3 Pro Designer, my turnaround time for forms design has been reduced by 40 to 50%, and I've eliminated outside typesetting and pre-production costs... More important than anything, I can play 'what-if' with my designs... it's made me a better designer."

Ask Dennis Muldoon, in-house forms specialist for ColorWeb Printing Corporation, "We sell service. We're often asked to meet tough deadlines for business forms."

F3 Pro Designer helps us eliminate time-consuming camera work and stripping. We output artwork, manufacturing and specification information on a laser printer and got rid of our typesetter. The bottom line is a form that used to take us six weeks to design, print and deliver, I can now turn around in *just five days*. I'm giving a copy to my brokers..."

"...my turnaround time for forms design and manufacturing has been reduced by 40 to 50%..."

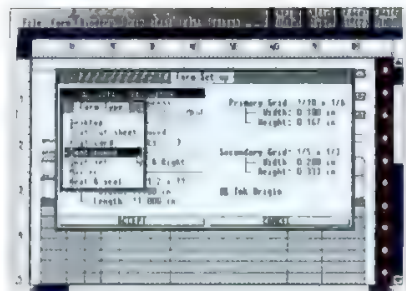


F3 Pro Designer allows you to specify print positions and design around them.

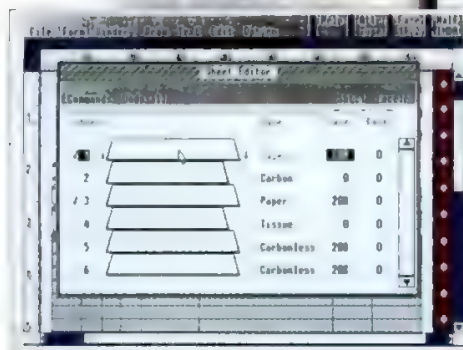
F3 Pro Designer treats each page of your pre-printed form as part of one single entity. This "Three-Dimensional Editing" allows you to design all the pages or parts of your form simultaneously. Move objects to other pages without manually "copying," simply tell Pro Designer where they go and they're instantly inserted.

Design Around Print Position & Print Devices...

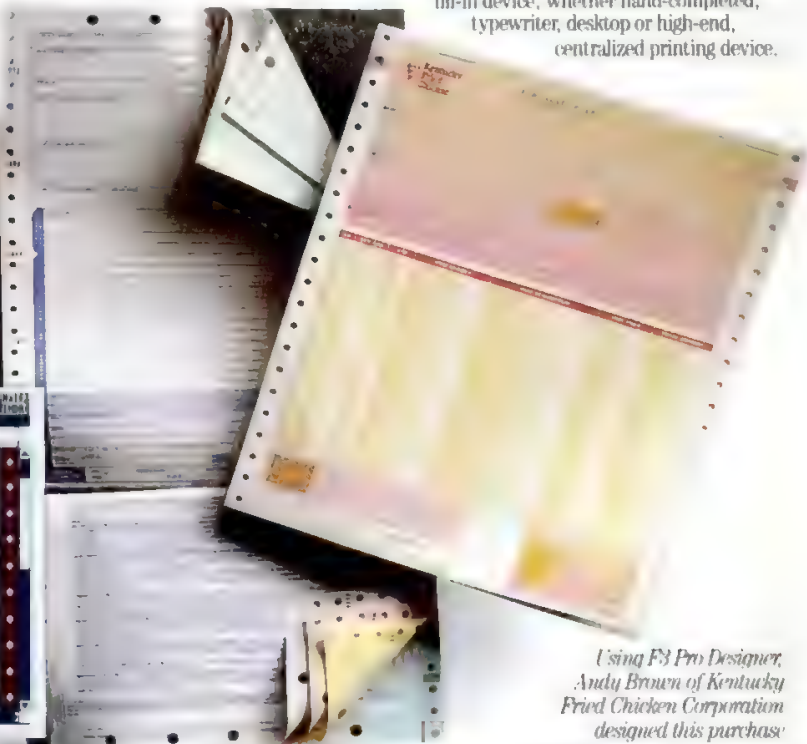
You can quickly establish precise strike positions for data then keep each position anchored into the design as other elements of the form change. In fact, enclosures can be created from your data positions — automatically — without any drawing. Pro Designer's "DataBlock" system enables you to reserve exact character sizes of the fill-in device, whether hand-completed, typewriter, desktop or high-end, centralized printing device.



From the F3 Pro Designer Form Set-up screen, you select the form type, number of sheets, customize data, and specify the grade of the fill-in device. By choosing the selection from continuous toward set the system automatically outlines changes artwork and overall sizes accordingly.



The Sheet Editor screen allows you to select on a sheet by sheet basis, sheet type, paper type and size. Also allows you to move, copy, delete, insert and overlay graphics from one sheet to another.



Using F3 Pro Designer, Andy Brown of Kentucky Fried Chicken Corporation designed this purchase order. He slashed turnaround time and outside expense, while producing better information flow.

...And Automatically Produces Camera-Ready Art And Fully Detailed Production Specs.

Drawing...

Developed by CAD and forms automation professionals, F3 Pro Designer satisfies the requirements of professional forms design. Its "Intelligent Line Drawing" gives you the ability to swiftly draw lines of any weight, grids, boxes, perfect circles, polygons, ellipses, arcs and just about any shape your design calls for with just one keystroke. Create vanishing screens (from 1 to 100 percent), shapes with pattern fills, dashed, dotted, tinted or patterned rules.

Text Editing Window...

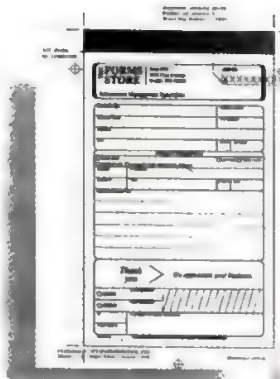
F3 Pro Designer's text editing window allows fast import of large bodies of text ("backers" for example), for fast formatting and inclusion on one page, several or every page of the form. Select from a full library of scalable Bitstream® Fontware that can be kerned, hyphenated, reversed, angled, rotated and aligned to professional standards. Change color and size character by character and automatically flow text from column to column.

Revisions...

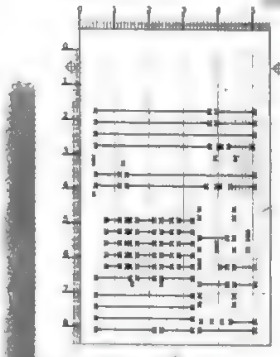
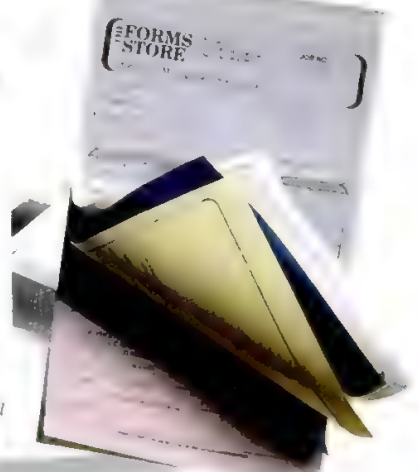
Forms design is a complex endeavor often requiring in-depth analysis and discussion. A finished form may represent dozens of revisions. When you make revisions, the system automatically integrates appropriate changes on each page. If the decision is made to change the format from unit set to continuous, for example, F3 Pro Designer makes all necessary construction changes, re-sets line lengths, re-draws the entire form and updates the manufacturing specifications — instantly.

Manufacturing...

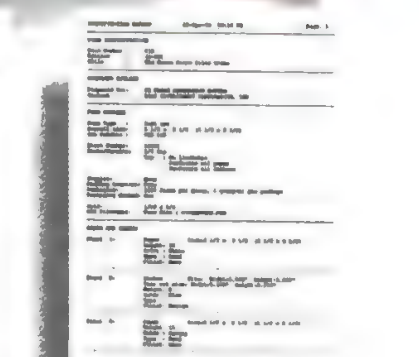
When the form is ready to go to press, F3 Pro Designer produces final camera-ready mechanicals for each page, with separated art for colors, tints, and special effects such as vanishing screens, logos and other graphic devices — ready for plating. Manufacturing specifications such as placement of holes, adhesives, crash numbering positions, perfs, windows, labels, marginal text areas, blockouts, die cuts and grip areas are precisely indicated. It produces "redline" areas for actual paper measurements (with crop marks), stubs, hole sizes and print positions.



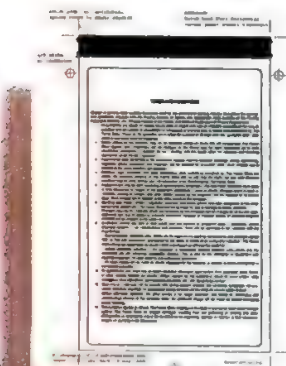
CAMERA-READY ART: This is the final annotated output of the form face. Notes specify stub, crash number and string information.



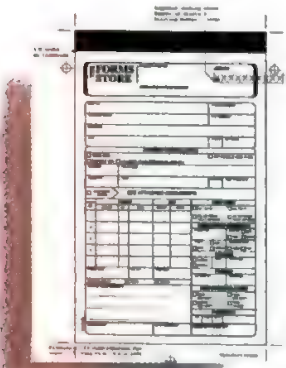
PRINT POSITIONS: Precise print positions are anchored to the form and remain in place throughout the design process.



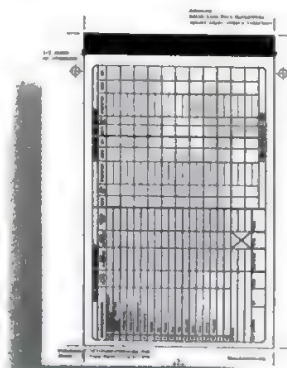
SPEC REPORT: A complete summary of specs and materials is automatically generated.



Backers can be easily imported from leading word processing programs for formatting.



This page receives a carbon imprint from page 4.



LAST PAGE - BACK: This sheet prints on 10 point stock and backs up the unit set.

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Letters

A LICENSE TO DRAW

I read Bill Machrone's column with amusement (Bill Machrone, *PC Magazine*, March 13, 1990). While his main point was obvious—well-behaved software, at last—I wondered whether he realized what else he was telling us?

His daughter's teacher wants some students to do art on a computer. What so amused me was Mr. Machrone's plan of attack upon this rather trivial problem: a 16-MHz 386 with 6MB RAM running *Micrografx Designer* under *Windows/386* with *PreScript* in the background. The output is then transferred to a LaserJet through a special high-speed hardware link. He ends the article by telling us "the right tools are worth it."

Sounds suspiciously like using a cannon to swat a fly.

Let's see what the fly swatter approach has to offer. I have a creaky old XT with a 32MB hard drive. I could fire up *Pictor* or *DeluxePaint II*. Both are fast and work comfortably in DOS's measly 640K. I could then choose black-and-white output (my Epson FX-85) or color (my Okimate 20), with output quality good enough to make any third-grader proud.

Allen K. Milakovic
Glen Rock, Pennsylvania

I wonder how the other 8-year-olds felt after they worked hours on an old XT with *Printshop* and an old dot matrix. These poor kids had to learn it all by themselves because their fathers were 45 years old and didn't like computers. I wonder how they felt when Stephanie Machrone turned in her design.

Finally, I guess it's okay to borrow software from work. Bill Machrone does it.

Robert L. Payette
Tacoma, Washington

Have I missed something here? I read that Mr. Machrone went "shopping" in the art department. By my guess, he picked up about \$1,000 worth of software to use for a home project on a different computer.



Just how much does it take to jump start a project?

In my business, we make every effort to comply with license agreements, even though this is sometimes inconvenient, inefficient, and expensive. I think you should consider your position in this matter; are you condoning the use of software in this manner? If so, I'm right behind you—we could save thousands by installing one package of *AutoCAD* on several computers. But I don't think Autodesk would agree very quickly.

Finally, there is a question of integrity. Do you do as you are legally bound to do, or do you do what's expeditious?

G. Alan Johnson
Lawrence, Kansas



The copy of *PreScript* was a beta version sent to *PC Magazine* for testing; the copy of *Designer* was registered to me. Ultimately, I buy all software for my home system. The touch shopping experience is (usually) fun and keeps me in touch with the market.

—Bill Machrone

THE WORKING (WIN)WORD

I just received the current issue and was ecstatic to see that there is a new section on word processing (The Working

Word, *PC Magazine*, March 27, 1990), and that it dealt with *Microsoft Word for Windows*.

I use that program on a 10-MHz 286 without expanded memory. Its performance is great. *Windows* is definitely the way to go right now, even on a brain-dead machine. No more character-based computing for me.

Rodney J. Wittler
Lakewood, Colorado

SCANNING DOT MATRIX

John C. Dvorak made a significant oversight regarding OCR in his Inside Track column (March 13, 1990). Calera Recognition Systems' products read dot matrix print (even draft quality) quite well. So well, in fact, that we routinely convert such images to text files and have even made a business of it.

Our ViaFaxx service allows anyone to use a fax machine as an OCR scanner. Documents are faxed on a toll-free fax number directly into our computer. Using Calera's software, we process the image to create the desired word processing or spreadsheet format. A ViaFaxx operator reviews the resulting file and corrects any errors, and the resulting clean file is downloaded to the user's PC.

We process typed, typeset, laser, and dot matrix documents in this way for customers throughout the U.S. and Canada. Accuracy is extremely high (even though fax resolution is only 200 dots per inch), owing in large part to the performance of the Calera software.

Robert G. Johnson
President
ViaPhone Corp.
Albany, New York

John C. Dvorak claims Xerox's *Accutext* is "the only OCR software that can read dot matrix print with any accuracy" (Inside Track, *PC Magazine*, March 13, 1990). With Mr. Dvorak's great experience, who's to argue. After all, we trust that he's at least done his homework.

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CIRCLE 180 ON READER SERVICE CARD

Letters

Unfortunately, he's absolutely wrong. Twenty-four hours before I read his column, with Calera's *Truescan* I scanned the worst possible dot matrix print directly into a *Lotus 1-2-3* worksheet, with no errors, no extra conversion, and no questions asked. And I've done that thousands of times for clients in my service bureau.

How dare you skip
the Utilities column,
by far the most
vital part of your
magazine. What
Macintosh jockey
made that decision?

I've tried them all, and Calera has very rarely let me down. Mr. Dvorak claims he "keeps an eye on Calera Recognition Systems." But how can he when he has no idea how well *Truescan* handles dot matrix print?

Mr. Dvorak should do his homework better.

Evan Burns

Winnipeg, Manitoba

TWO VOTES FOR MULTIMATE

After reading your recent review of *MultiMate*, Version 4.0 (First Looks, *PC Magazine*, March 13, 1990), it was obvious that some of the people reviewing for your magazine haven't the foggiest idea of what is meant by objectivity.

The enhanced version of this program is loaded with so many marvelous features that it is practically a new product. For your magazine to single out two products, *WordPerfect* and *Microsoft Word*, as the only word processors worth buying is ludicrous. The overwhelming majority of users don't use 90 percent of the features of either of these fully loaded programs on a day-to-day basis.

Mark Weinblatt

Great Neck, New York

NO ROOM FOR STEREOTYPES

Jim Seymour's statement (*PC Magazine*, March 27, 1990) that "the Japanese believe they're the world's superior race" will probably receive supercilious nods of approval from the 'Amerika uber alles' set, but it has no place in any serious, objective discussion of computer issues.

What gives Seymour the idea that he is entitled to make such a statement? Even if he has Japanese blood, such a categorical, simplistic statement would only reveal him to be the Japanese-American version of a wannabe, rather than providing any legitimacy for his statement.

Edgar J. Lawrence

Dayton, Ohio

THE VOICE MAIL ALWAYS RINGS TWICE

The reader response to John C. Dvorak's December 26 column on voice mail was very interesting, especially those letters from people whose companies use voice mail. (Letters, *PC Magazine*, March 27, 1990).

However, my company has decided not to install a voice message system for many of the same reasons that Mr. Dvorak mentioned in his column. Our company is known for and prides itself on its dedication to client service. When clients call, they expect to be able to speak immediately to someone who can help them.

When dealing with suppliers as a client, I prefer to work with people rather than machines. A receptionist can usually tell me when to expect a return call, suggest someone else who can help, or even nag the called one into returning my call. When voice mail systems can do all that, maybe then I'll start buying from companies that use them.

C. P. Littlefield

Montclair, New Jersey

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W. M. P. Dunne's comments (Letters, *PC Magazine*, March 13, 1990) make an important point: "As a user of *WordPerfect* ... I must point out that the left-sided function keys are a working necessity."

Perhaps the problem is not in the keyboard, but in *WordPerfect*: its user interface is *hardware dependent*. Learning it on one hardware platform does not equip you to use it on others. In fact, the various *WordPerfects* for the PC, Mac, and VAX seem less like versions of the same program than different programs that happen to share the same file format.

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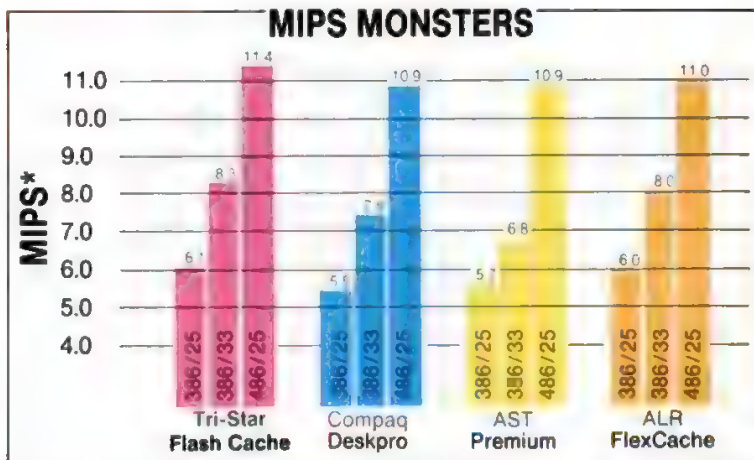
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Letters

IBM's Common User Access guidelines have defined a user interface independent of both the keyboard and the display. *WordPerfect* has announced that its next release for OS/2 will more or less conform to CUA, but why stop there? Why not make *WordPerfect* work the same way on every machine? Then it might truly be perfect.

Alan T. Chattaway
Vancouver, British Columbia

SCHEDULE.COM-PLIMENT

I've got to tell you as an ardent user of the *WordPerfect* calendar that SCHEDULE.COM (Utilities, *PC Magazine*, March 27, 1990) is the easiest and most forthright program I have ever used. My congratulations and sincere thanks to Michael J. Mefford for this fine effort.

Howard Pearlman
Honolulu, Hawaii

... AND A COMPLAINT

I am writing to complain about the March 13, 1990, issue. There is no Utilities column. How dare you skip the most vital part of your magazine? What Macintosh jockey made that decision? I look forward to the utility column every issue for new ideas on how to squeeze the last drop of performance from my computer. I hope you guys get a lot of hate mail over this lame decision. You deserve it!

Joseph L. Johnson
Newark, Delaware

LAN FAX GATEWAYS

The article "LAN FAX Gateways: Can They Eliminate Fax Machine Bottlenecks?" in the April 10, 1990, issue of *PC Magazine* has done an appalling disservice to your readers. The dizzying array of Local Area Network products forces many readers to look to publications such as yours to review products and to provide objective comparisons. Sadly, the LAN Fax Gateways article does neither.

In their article, Unger and Derfler flatly state that the products mentioned are "... the only hardware and software combinations available to make your network fax-capable." This is absurd. Alcom has been providing its EasyGate and LanFax facsimile gateway products since 1988, and our products were conspicuously absent from the article.

Alcom is the market leader in Document Communications Servers, which provide LAN e-mail users with facsimile, telex, MCI, and Western Union EasyLink connections. Alcom's LanFax Gateway facsimile servers are available for Banyan, Novell, and 3Com networks and are compatible with a large and growing list of the most popular LAN e-mail packages including all MHS-compatible e-mail and workgroup systems. Alcom's LanFax Redirector facsimile servers provide shared-resource fax services to LAN users through any application compatible with the Intel/DCA CAS standard. There are more Alcom facsimile servers installed worldwide than any other brand of PC LAN facsimile gateway.

Richard A. Milewski
Director of Product Marketing
Alcom, Inc.
Palo Alto, California



PC Magazine regrets the omission of Alcom's product from the article. Although it differs in several respects from the products reviewed, it is well suited to its defined task.—Ed.

CORRECTIONS & AMPLIFICATIONS

The review of Touchstone Software's *CheckIt* (First Looks, *PC Magazine*, April 10, 1990) states that the program does not test expanded memory; it does.

The correct phone number for OCR Systems (*PC Magazine*, New & Improved, March 27, 1990) is (215) 938-7460.

Contrary to what was reported in our features table, the Epson Equity 386SX ("386: The New Corporate Standard," *PC Magazine*, January 30, 1990) features SIMM RAM packaging with a maximum of 14MB of add-in board memory.

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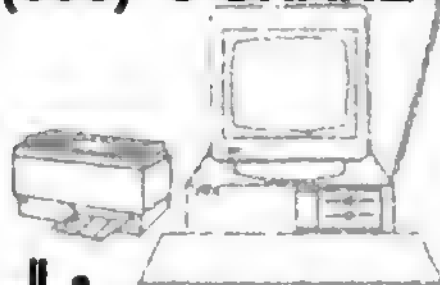


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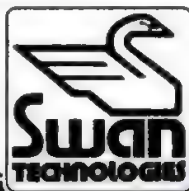
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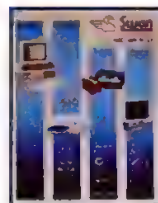
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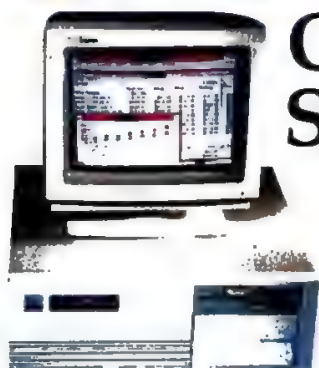


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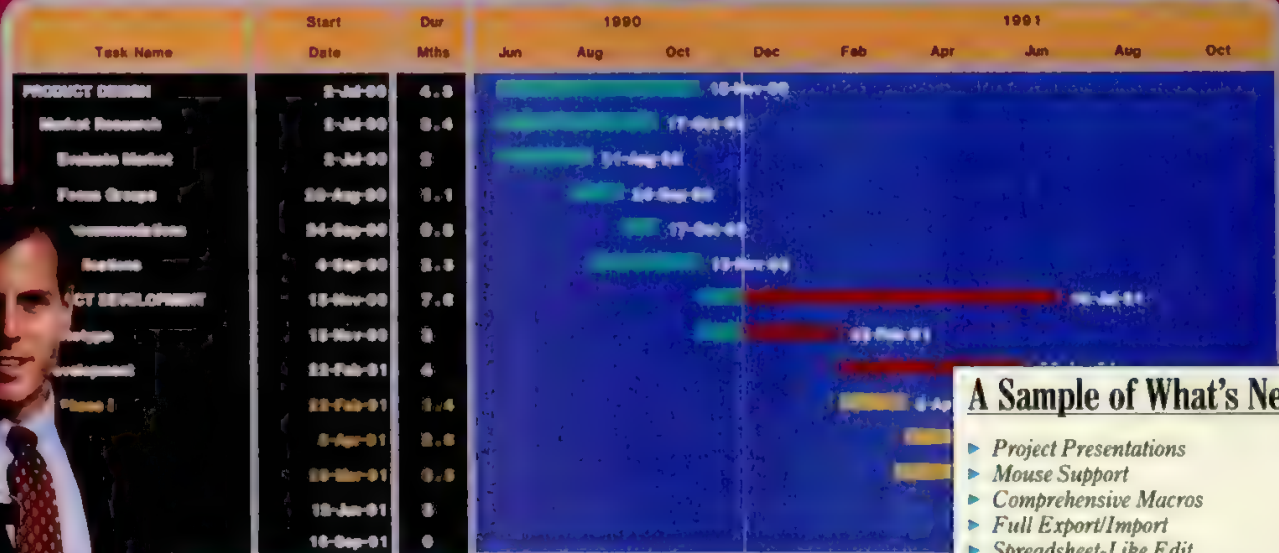
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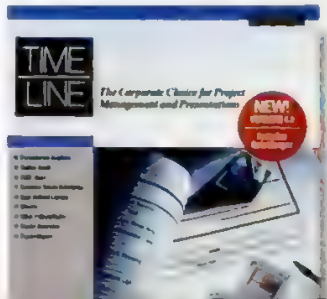
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Advisor

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Russ Binder
Glendora, California

 First, you might want to take a look at the Advisor column in the January 16, 1990, issue of *PC Magazine* for a discussion of dictionaries of computer terms.

Next, all of our utilities, as well as a file that lists them, are available in the UTILITIES database on PC MagNet in the file UDCAT.ARC.

As for an index of back issues, you have several choices—most of which require a modem. A non-Ziff-Davis offering, PC Reviews, provides an on-line searchable database of citations and abstracts of reviews and articles for all the major computer publications, including *PC Magazine*. The service costs a flat \$8.95 per month (plus long-distance phone charges for non-New-Jerseyites), and the abstracts are downloadable. You can log on and run through a free demo (BBS phone (201) 653-7688; 1,200 bps maximum speed, no parity, 8 data bits, 1 stop bit), or call Compatible Technologies Group and speak with a human (P.O. Box 8299, Jersey City, NJ 07308; (212) 463-8989).

Ziff-Davis offers a few ways to get the information as well. You can download search software and a database of *PC Magazine* reviews for 1988 and 1989 from the UTILITIES database (filenames: PCM.EXE, PCSRCH.EXE, and PCM.INF). Note, however, that the first two files are 500K and 118K, respectively; that's about one and a half hours of connect charges at 2,400 bps, and more than 2MB of disk space when decompressed (they are self-extracting). The same cita-

- **WHERE TO FIND IT:**
Article databases, *PC Magazine* utilities, and company addresses.
- **OUTPUT DETOUR:**
Redirecting output from a printer to a file.
- **PROGRAMMING EMS AND XMS:**
How to get the documentation for LIM EMS 4.0 and XMS.

tion index, with a different search engine, can be used on-line at no extra charge—type GO REVIEWS for access.

The index is a subset of Computer Library's *Computer Periodicals Database*, a full-text CD-ROM database of 130 computer-related publications (\$765 per year, updated monthly; Computer Library, Ziff Communications Co., One Park Ave., New York, NY 10016; (212) 503-4400). A similar database also resides on PC MagNet and can be accessed by typing GO COMPLIB; in addition to connect charges, there are surcharges for viewing and downloading information.

Alternatively, you can download PCIDX8.LZH from Data Library 2 of the UTILFORUM, which contains citations for 1989 issues in comma-delimited ASCII and .DBF format.

Finally, I've yet to see a truly complete directory of hardware and software companies, but I have been able to kludge the information together from several places. So far, I've found that the best single source is the *COMDEX Program and Exhibits Guide* (\$70; send checks to the attention of Rose Kelly, The Interface Group, 300 First Ave., Needham, MA 02194; (617) 449-6600). The guide is free to all show attendees and available after

each show. The fall issue tends to have more information than the spring, since the former has more exhibitors.

Ziff-Davis also publishes *Data Sources*, a listing of hardware and software for all computers, including mainframes and minis (\$575 subscription, \$350 for a single set; Ziff Communications, One Park Ave., New York, NY 10016; (212) 503-3500, subscriptions (609) 354-4999). The same listings are available on PC MagNet as Computer Directory, for the cost of connect time plus surcharges; type GO COMPDIR to access.

One last suggestion is General Information's *Computer/High Tech Infopack* (\$129; 401 Parkplace, Kirkland, WA 98033; (800) 722-3244, (206) 828-4777, fax (206) 827-8562), a .DBF-format database with the names, addresses, and phone numbers of 8,500 companies. Although the package is designed to work with the company's excellent TSR dialer *Hotline*, it can be used with any program that reads .DBF files.

OUTPUT DETOUR

I am looking for a way to redirect all output from the printer to a file on-disk. The usual examples (in the DOS manuals and other books) only show how to do this for DOS commands like DIR and SORT. What I want to know is whether such redirection can be done more or less permanently, so application programs can have their printer output placed in a file.

Peter Clark
Anchorage, Alaska

 The simplest solution is the venerable PRN2FILE, a *PC Magazine* utility that's been around since 1987—you can find it in Data Library 2 of the UTILFORUM on PC MagNet (filename: PRN2FL.COM). The memory-resident program only takes up about 6K and reroutes any printer-directed output to a user-specified file. It can be unloaded and disabled from the DOS command line and will append successive print

Advisor

requests to an already existing file. A related utility, PRNTEE.COM, lets you output to both the printer and a file.

A \$10 shareware utility, PRINDIR, gives you hotkey toggling among screen, printer, and file redirection. You can order the program directly from Techniform Industries (2107 Hayes Ave., Fremont, OH 43420; (419) 332-8484), or download it from Data Library 3 of the IBMSYS forum on CompuServe (filename: PRINDI.ARC).

In addition, there are some more-sophisticated shareware print spoolers that give you redirection capability, such as DMP (\$18; DMP Software, 1223 Wilshire Blvd., #199, Santa Monica, CA 90403). Also available in Data Library 8 of the UTILFORUM on PC MagNet, under the filename DMP.ARC). DMP comes with a utility that allows you to print the files from the DOS command line, in lieu of DOS's PRINT or COPY commands. The company also sells a similar program, LaserZ (\$29 plus \$3 for shipping), which

provides PostScript printer support. *Disk Spool II* offers redirection and spooling as well (\$34; Budget Software Co., P.O. Box 12282, 12162 E. Mississippi Ave., Aurora, CO 80012; (303) 695-9095. Available in Data Library 2 of the UTILITIES database on PC MagNet under the filename SP2.ZIP).

PROGRAMMING EMS AND XMS

I'd like to implement EMS 4.0 support in an application I'm writing and need the details of all the functions. Where can I find the complete specification?

Also, I'm interested in XMS, but I cannot find anything about it. Do you know where I can get detailed information about it? Do you know how I can get the driver software? (Is there a vendor selling an XMS driver, or are these specifications for Microsoft's internal use only?)

László Élétő
Budapest, Hungary



Never fear: both the LIM EMS 4.0 (Lotus-Intel-Microsoft Expanded Memory Specification) and the XMS 2.0 (Extended Memory Specification) are freely available.

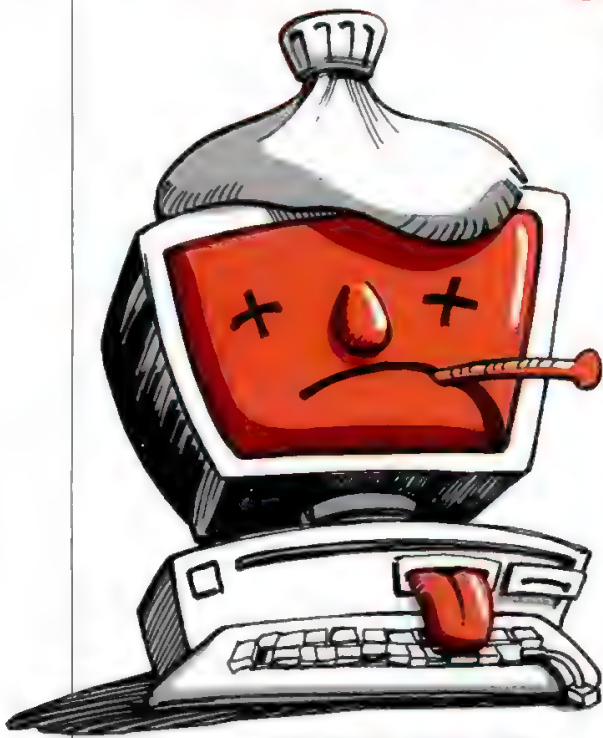
For the EMS spec, you need to write, phone, or fax your request to Intel (CO3-07, 5200 NE Elam Young Pkwy., Hillsboro, OR 97124; (800) 538-3373, (503) 629-7362; fax (800) 458-6231). Alternatively, you can download the specification (filename: EMS4.ARC) and programmer's toolkit from the Intel bulletin board (BBS (503) 645-6275, settings no parity, 8 data bits, 1 stop bit), but be warned that it consists of more than 300K worth of *compressed* files.

To get a copy of XMS information, you can either write or call Microsoft (16011 NE 36th Way, P.O. Box 97017, Redmond, WA 98073; (800) 426-9400, (206) 882-8080), or download the HIMEM.SYS driver, source code, and the spec from Data Library 7 of the MSSYS forum on CompuServe (filename: XMS.ARC).

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Ave., New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). Please specify your equipment. ■

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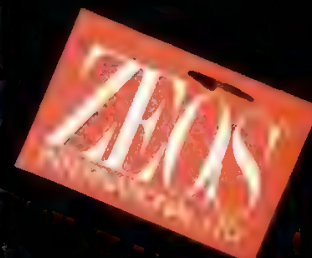
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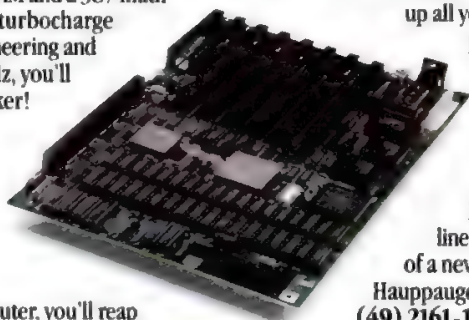
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CIRCLE 276 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

Sharp Multi-Color 386: Heavyweight Portable Packs Color VGA Display

HANDS ON
by Mark Jones

With its PC-6220—a 4.4-pound notebook laptop we reviewed last issue—Sharp earned bragging rights to the smallest, lightest 286 machine; the smallest, lightest machine with a VGA-compatible display; and the smallest, lightest machine with a hard disk. As this issue was drawing to a close, we got our hands on the Sharp Multi-Color 386. Though hardly small or light, this lunchbox-style portable breaks new ground of its own.

The Multi-Color 386, also known as the PC-8000, joins the NEC ProSpeed CSX in the fledgling, color-display portable category (see *PC Magazine*, October 31, 1989, page 33). Though highly notable for its early appearance, the 10-inch NEC ProSpeed CSX display is disappointing at best. The 14-inch Sharp display easily surpasses the NEC in every aspect of image quality.

Now for the bad news. While the Multi-Color's 20-MHz 386 processor, 2MB RAM, 19-millisecond (ms) hard disk, and other features give it all the muscle you could ask for in a portable, this power comes at a significant cost and an unwieldy weight. Our evaluation unit, complete with the 80MB hard disk, carried a suggested list price of \$9,995. The machine weighed in at 29.2 pounds. (That's 6.6 UltraLites; 1.6 ProSpeed CSXs; or a

CONTINUES ON PAGE 34

The Sharp Multi-Color 386's 20-MHz 386 processor, 2MB RAM, 19-ms hard disk, and color VGA display give this portable a lot of muscle.



Microsoft C 6.0 Offers Many Reasons to Upgrade, Few Reasons to Switch

by Richard Hale Shaw

For users of Version 5.1 of Microsoft C, the payback for spending \$125 to upgrade to Version 6.0 lies in meaty enhancements like an improved optimizer, debugger, libraries, and CodeView; better OS/2 support; tiny model programs and .COM file support; and new language extensions. But for C programmers who might be tempted to pay \$495 to switch from another compiler to Microsoft C 6.0, features like the integrated environment and marginal improvements in the size and speed of generated code offer sizzle rather than

steak.

The Programmer's Work Bench (PWB) is new in C 6.0. Like Turbo C, it brings together a C compiler, a linker, a make utility, and an editor in a character-mode environment. (Unlike Turbo C, the PWB and its components are disk based.) The PWB remembers debugging configurations and breakpoint settings between sessions; these are saved on a project-by-project basis. It also boasts a source code browser, the CodeView debugger, and the Advisor, an on-line reference guide.

The environment is fully extensible via C and macros. At its heart is Microsoft's Editor, now featuring pull-down menus and

pop-up dialogs, 200 levels of UNDO, a macro language with recordable macros, and a reconfigurable, extensible keyboard interface.

The Source Browser uses a new compiler option to build a knowledge base of the relationships between program objects. It can show you a map of a program's structure, the calling relationships between functions, which functions use which variables, and their definitions. It also maintains a complete history of your browsing activities. The Advisor, also found in Quick C, is available as hyper-text-based, context-sensitive on-line help, with extensive in-

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First Looks

Multi-Color

CONTINUED FROM PAGE 33

healthy weight for a three-year-old child.) After about 30 seconds of carrying this machine, one is tempted to make it walk by itself.

Sharp is marketing the machine as a personal workstation for crowded desktops and as a presentation tool for "internal corporate meetings, client presentations, and sales calls." Though unquestionably of the lunchbox variety, the Multi-Color 386 is thinner and much more stylish than most in the class. The chassis measures 15.1 inches high, 15.5 inches wide, and 7 inches deep, and sports rounded edges and a dark gray finish.

The Multi-Color's display makes its first strong impression with sheer size. Measuring 11 inches wide and 8.4 inches high, the screen is as large or larger than that of many desktop CRTs.

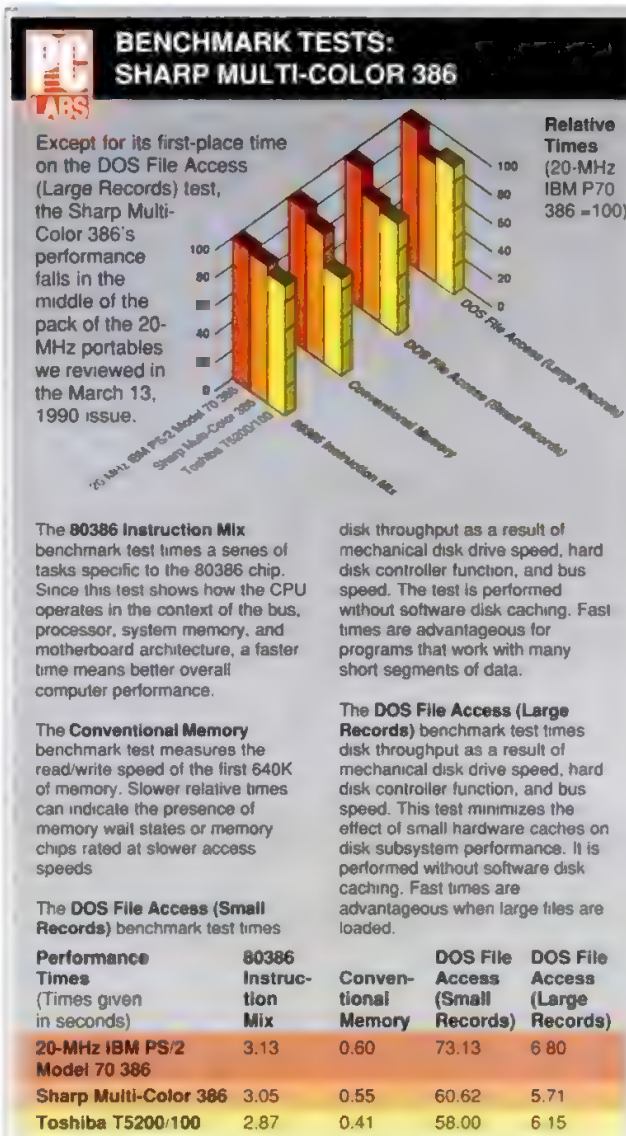
Image quality, while far superior to that of the ProSpeed CSX, suffers somewhat from the limitations of currently available display technology. Sharp, Hitachi, IBM, and others are hard at work on active matrix LCD displays, which rival or better their CRT counterparts in overall image quality. These displays should make their debut in the PC market sometime next year.

In the meantime, the Multi-Color display probably represents about the best that traditional LCD technology has to offer. Instead of using a single LCD layer, as does the NEC ProSpeed CSX, the Multi-Color uses two in a standard, double-twisted arrangement. As with the NEC, red, green, and blue filters side-by-side over each pixel provide the color.

The Multi-Color also boosts screen brightness by using hot, as opposed to cold, cathode fluorescent tube backlighting. HCFT backlighting ionizes the Mercury vapor in the tube by heating filaments rather than applying a voltage across an anode and diode. The disadvantages of



The Multi-Color 386's VGA-compatible display represents about the best that traditional LCD technology has to offer.



FACT FILE

Sharp Multi-Color 386

Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430-2135; (201) 529-9500

List Price: With 2MB RAM, 3.5-inch, 1.44MB floppy drive, 40MB hard disk, 14-inch color VGA display, DOS 4.01, \$9,395; with 80MB hard disk, \$9,995.

In Short: The 386-based Multi-Color 386 is the first portable to offer a color, VGA-compatible display. Its 29.2-pound weight will make it a chore to lug around.

CIRCLE 448 ON READER SERVICE CARD

HCFT backlighting include increased power consumption and shorter tube life.

While the two LCD panels and the power demands of the HCFT backlighting undoubtedly account for part of the Multi-Color's overweight nature—radio signal shielding also adds quite a bit of weight—the results are pleasing, if not spectacular. Colors are somewhat washed out and uneven, but not nearly as much as those of our early NEC ProSpeed CSX evaluation unit. These colors won't look great when compared to your desktop monitor, but they're good enough, even for most presentations.

The Sharp Multi-Color 386, boasting a top resolution of 640 by 480, also provides full VGA compatibility, or at least close to it. The display passed all PC Labs VGA register-level compatibility tests with flying colors and worked in every VGA mode. According to Sharp's specifications, the Multi-Color displays up to 256 colors simultaneously from a palette of 512, and herein lie the VGA shortcomings. True VGA graphics draw from a palette of 262,144 colors. Also, our evaluation unit seemed capable of only about 128 simultaneous colors, give or take a few. While the Sharp Multi-Color did an admirable job of displaying all of our test images, some images understandably suffer somewhat from these limitations.

To put all of this in perspective, one should remember that

First Looks

the ProSpeed CSX offers a top resolution of 640 by 400 resolution and displays only 16 simultaneous colors from a palette of 64. As a result, it supports only EGA graphics.

Sharp did an especially nice job of reducing ghosting in this display. With the ProSpeed CSX, images seem to fade into the screen, and any fast image movement results in serious ghosting. The Multi-Color still may not be your machine of choice for fast-moving animation, but the display is certainly usable for most applications, even relatively tame arcade games such as *Tetris*.

Narrow viewing angle is still a problem with this color display, as it probably will be with others until active-matrix technology hits the market. The Multi-Color display is readable through an angle of about 30 degrees to each side from center. The Multi-Color comes standard with an external VGA monitor connector for times when a 60-degree viewing cone just won't do. The internal display will not run concurrently with the external.

The Multi-Color 386 comes relatively well equipped in either its \$9,395, 40MB version or the \$9,995, 80MB version. Our 80MB unit came with a 3.5-inch Quantum ProDrive disk rated at 19 ms.

Other standard equipment for the Multi-Color includes a 3.5-inch, 1.44MB floppy disk drive, one parallel port, one serial port, one external FDD connector, and PS/2-style, mini-DIN connectors for both the keyboard and a Microsoft In-Port-compatible mouse.

The machine comes standard with 2MB of 80-nanosecond (ns) DRAM, but you won't get access to all of it: the machine reserves 384K for shadowing system and video BIOS. Connectors on the planar board allow installation of up to six additional megabytes of 32-bit RAM. The planar board also makes room for an 80387 math coprocessor.

Additional RAM, for a total

of up to 15MB, can be added via the standard, 16-bit expansion slots. The slots accommodate one half-length board and one full-length. Installing the cards requires only removal of the back cover, which is attached with seven screws. A plastic door along the right edge of the machine's base snaps open for easy access to the expansion card end brackets. Back-panel switches include a three-position speaker volume control that allows you to turn the speaker to low volume, high volume, or

off.

Of course, this color-display heavyweight insists on running close to a power outlet. Between the HCFT backlighting, the display driver circuits, and the 20-MHz, 32-bit processing, the Multi-Color 386 demands more power than a manageable battery pack could supply for any useful amount of time. The internal power supply, which accounts for a nontrivial portion of the machine's size and weight, carries a 110-watt rating. Two small cooling fans rest

along the top rear panel of the machine.

The Sharp Multi-Color 386 is sure to appeal to some buyers, especially those who need a color portable that can be moved from room to room for in-house demonstrations. Compared to the alternative—the NEC ProSpeed CSX—the Multi-Color offers a much better display, not to mention the greater speed its 20-MHz 386 affords. But be prepared to buy a luggage carrier if you plan to take this portable on the road. ■

Microsoft C 6.0

CONTINUED FROM PAGE 33

dexing and facilities for cutting and pasting program examples directly into your program. The documentation includes "Advanced Programming Techniques," which is organized around specific programming problems and tasks. Since the printed documentation relies heavily on the Advisor, it's been condensed considerably. In fact, the runtime library reference has been replaced with summaries, and the detailed library reference is not included in the \$495 package but is now a separate \$22.95 purchase from Microsoft Press.

In addition to the optimizing compiler and standard linker, the PWB also offers an incremental compiler (from Quick C), which only needs to recompile those parts of a program that have changed. Complimented by an incremental linker, it can be used until development is complete, at which time you switch to the optimizing compiler. Finally, the PWB features project management facilities that simplify MAKE file generation. You can add to MAKE files by selecting filenames from a list box, or have the PWB scan source files for header filenames. Options for release and debugging compilations are separately maintained, so you can switch between them with a mouse click.

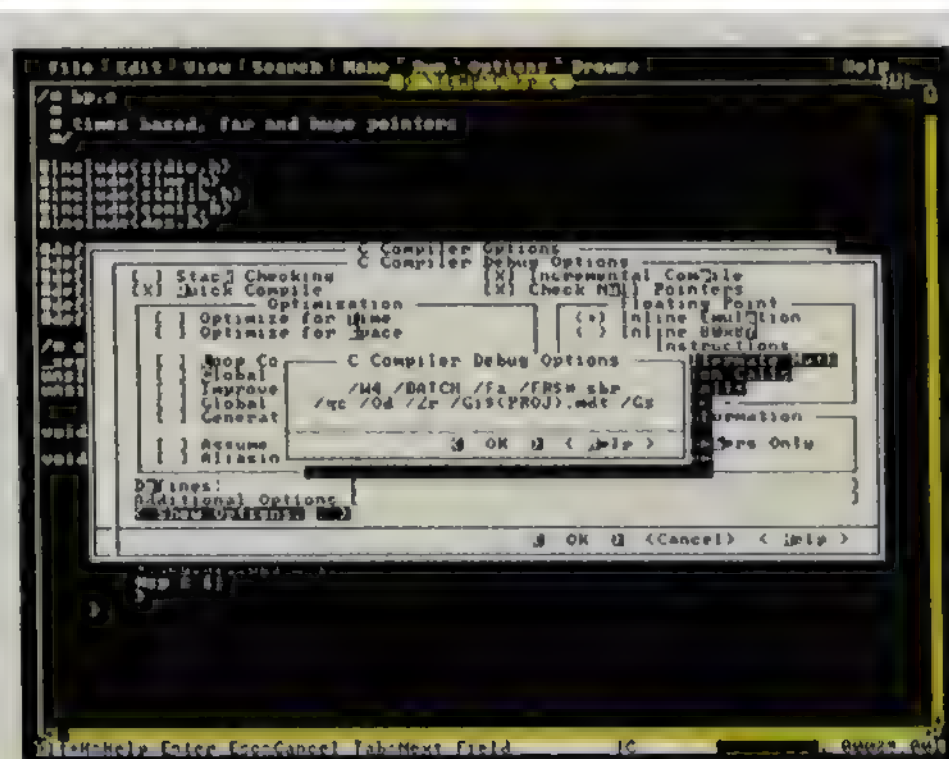
The purpose of the PWB is to give you more time to focus on the program you're writing, while minimizing the distractions of program development. To this end it's successful; but

while its components are each extremely useful, their integration in the PWB tends to be a bit disappointing. From mouse response to pull-down windows, the interface is slow and cumbersome. There is no configuration dialog; for example, you have to type hex values into a configuration file to change colors. State-of-the-art technology? In 1985, maybe.

The PWB doesn't take full advantage of the fine tools provided in C 6.0. The PWB uses the new NMAKE utility for project management. But because it only uses a subset of NMAKE's commands, the PWB can only build one target program or library at a time. NMAKE itself is far more powerful, with directives for conditional program builds, macros with string substitutions, and

options for accessing lists of files.

Other C 6.0 utilities outweigh the shortcomings of the PWB. For instance, CodeView 3.0 sports a new, faster interface and uses far less memory than its predecessor: with 500K of extended memory installed, CodeView will switch to protected mode and consume less than 20K on DOS machines with a 286 or higher processor. You can view multiple source files and memory locations at one time, and dynamically record and replay every aspect of a debugging session. CodeView automatically saves breakpoints, watch windows, and settings between sessions. And, the new interface offers several new windows and improved OS/2 support. You can select and freeze multiple program



Microsoft C 6.0's Programmer's Work Bench offers integrated access to C compiler, debugger, editor, and source browser.

First Looks

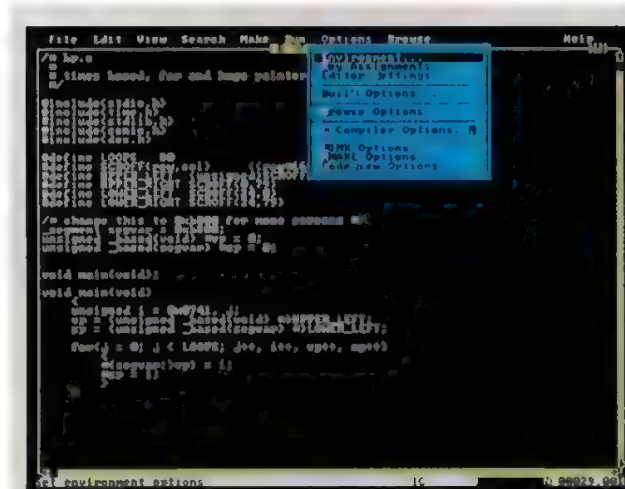
Microsoft C 6.0

CONTINUED FROM PAGE 35

threads by pointing and shooting, and debug OS/2 dynamic link libraries (DLLs).

Overall, C 6.0 offers improved support for OS/2: documentation and facilities for writing and building DLLs and multithreaded applications (even multithreaded DLLs) have been enhanced. The multithreaded library will let an application create as many threads as OS/2 will allow. The runtime library has also been expanded to include text-oriented graphics under OS/2.

C 6.0's new language extensions bring C closer to the machine and take advantage of natural optimizations via in-line assembly language. The new



Dialog boxes in Microsoft C 6.0's Programmer's Work Bench organize the compiler options.

fast-calling convention lets you pass function parameters in registers, while based pointers use segment overrides to offer the addressing power of far pointers

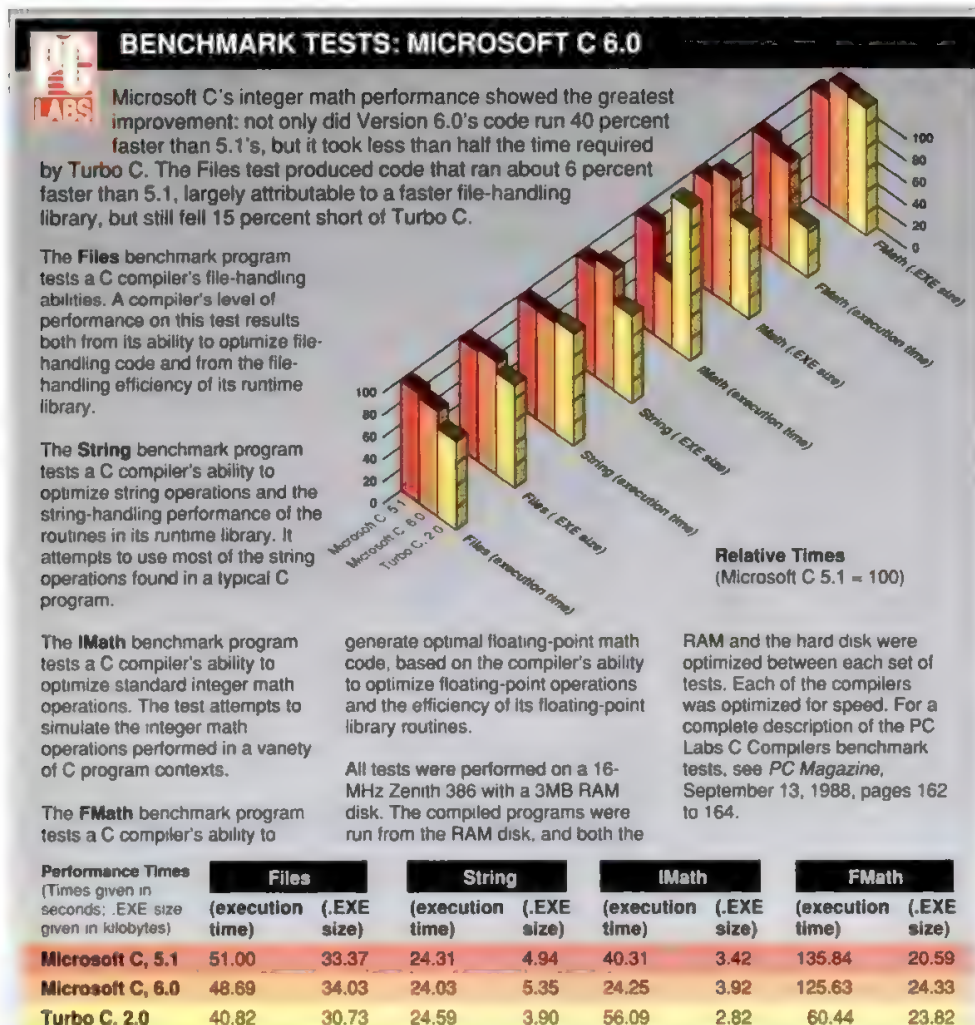
with the size and some of the speed of near pointers. C 6.0's optimizer now lets you control optimization at the function level, and globally optimizes regis-

ter usage as well as eliminates common subexpressions.

But, while C 6.0's optimizer is more aggressive than the one in C 5.1, the payoffs are strictly marginal: on the PC Labs benchmark tests, we found that with full optimization on, code compiled under C 6.0 was 1 to 18 percent larger than the C 5.1 versions. And in no case were executables produced by C 6.0 smaller than those produced by compiling the same benchmark tests with Turbo C.

However, C 6.0 code execution times ranged from 6 to 40 percent faster than C 5.1, the best being the integer math benchmark test, which took less than half the time required by Turbo C. In the other benchmark tests, Turbo C matched or beat C 6.0 (the Turbo C floating point benchmark test finished in less than half of C 6.0's time), not to mention that Turbo C compiled and linked the benchmark tests in one quarter of the time required by C 6.0.

For \$125, users of C 5.1 should upgrade. But unless you need OS/2 or Microsoft Windows support, or some other Microsoft C-specific feature, don't hurry: the PWB and improvements in the optimizer are not reasons enough to switch. ■



FACT FILE

Microsoft C 6.0
Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; (206) 882-8080.
List Price: \$495; \$125 upgrade for users of C 5.x.
Requires: 512K RAM (640K conventional memory and 384K extended memory recommended), 5MB hard disk space (10MB recommended), DOS 3.x or later or OS/2 1.x.
In Short: A powerful, complete C development system with optimizing compiler, incremental compiler and linker, CodeView debugger, source code browser, on-line help, Editor, and integrated interface. Upgrading is a must for C 5.1 users. But lackluster code size and speed, combined with a poorly implemented interface should give pause to those who are considering switching from other compilers.

CIRCLE 430 ON READER SERVICE CARD

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CIRCLE 299 ON READER SERVICE CARD

First Looks

R:BASE 3.0 Offers Full SQL, Improved Relational Facilities, Easy-to-use Interface

HANDS ON
by Richard Hale Shaw

While PC-based database management systems (DBMSs) continue to gain new features and capabilities, they're also getting easier to use. Case in point: *R:BASE 3.0*. The \$795 package from Microrim now supports full ANSI 2 SQL, offers multiuser auto-refresh and extensive new relational facilities, and has a completely new user-friendly interface.

While the new *R:BASE* interface is character-mode only, it's fully mouseable, with pull-down, shadowed menus and list boxes. The older Prompt By Example and "R>" prompt command mode are still available, but the new interface is more logical, accessible, and consistent. Including touches borrowed from flat-file databases like *Reflex* (such as field selection list boxes), it also offers a better placement of function keys and on-line help. While the

mouse response could be snappier, you'll find *R:BASE* easier to use than ever before.

Form, report, and label generation have been improved in *R:BASE*. You can still create custom forms and reports, but you can also generate quick versions from a single table. *R:BASE* forms allow you to attach command files to field entry and exit points, as well as customize field-level help text. Reports can be previewed on-screen, and it's easy to incorpo-

rate a variety of embedded print styles in both reports and labels.

Microrim has improved *R:BASE*'s networking facilities, too, with an auto-refresh facility that updates displayed data that other users have changed. While *Paradox* will automatically refresh displayed records, it won't let more than one user edit a record simultaneously. *R:BASE* does allow this activity, and when you save the changes to a record, *R:BASE* will notify you if the changes conflict with those made by someone else. It then gives you the choice to accept the other person's changes and discard your own, or you can simply overwrite them.

The *R:BASE* Query facility is now full Query-By-Example (QBE), and it makes query building a cinch. You can toggle between QBE and data browsing, or format several aspects of the Query screen and results: column order, width, position, and color as well as whether columns are displayed. The QBE interface visually resembles the one found in *Paradox*; but unlike *Paradox*, *R:BASE* can save a query as a relational VIEW, letting you (or your applications) open the VIEW to access only the rows and columns retrieved in the saved query.

Indeed, *R:BASE*'s extensive support for relational VIEWS and ANSI 2 SQL with transaction processing puts it in the big leagues of relational databases. Rather than scattering database objects (such as tables, reports, queries, and views) around your disk, *R:BASE* maintains a DB2-style system catalog and organizes everything in databases. When you open a database, all its objects are available. The DBMS allows you to incorporate data integrity rules into the database. By using these to control data access and validate data entry, a developer can prevent users from using the interactive interface to go around data integrity constraints ordinarily created at the application level.

The interface also sports a nice set of relational tools to let you take advantage of major re-

BENCHMARK TESTS: R:BASE 3.0

Although *R:BASE 3.0* is no match for its predecessor, *R:BASE* for DOS on the Import, Sort, and Search tests, it yielded outstanding times on the Delete and Index test for both 5,000 and 50,000 records.

That's because *R:BASE 3.0* offers full ANSI SQL support, which allows the program to take advantage of SQL's powerful set-oriented data management features.

To create a subset of columns with *R:BASE 3.0*, the user must define a VIEW (a subset of rows and columns of another table). The VIEW definition is a simple SQL SELECT command. To complete the benchmark test, the user renames the original table, and then creates the VIEW using the original table's name. Other databases require the user to copy the columns to a new table, and then use that table. To use the original table's name, the old table is deleted and the new one is renamed.

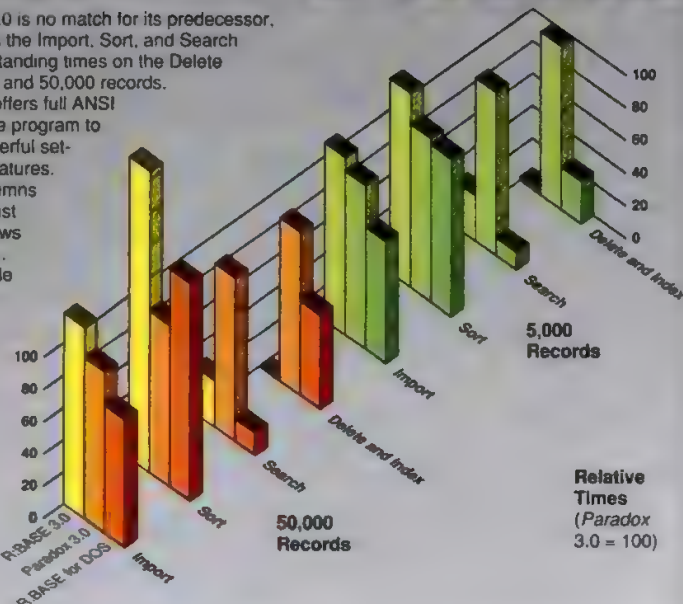
The **Search** test measures the time it takes to locate the first record that satisfies two criteria (make = Fendhi and model = coupe).

The **Delete and Index** (four-column version) test measures the time required to remove four columns (Units, SellPrice, BuyPrice, and TranDate) from a Product table created for this task and then, if necessary, to reindex the file.

The **Import** test measures how quickly the database can import an ASCII file (of either fixed field length or

comma-delimited format) with an index on the first field. We include the indexing portion of the test to avoid penalizing programs that automatically index the first field during the data conversion. Some programs require a two-step process for this test: an import followed by indexing.

All tests were performed on a 16-MHz PS/2 Model 80-071 equipped with a 70MB hard disk, 8MB RAM, and DOS 3.3. CONFIG.SYS contained the following specifications: FILES=20, BUFFERS=20. No other drivers or programs were loaded or running.



Performance Times (Times given in seconds)

50,000 Records

5,000 Records

	Import	Sort	Search	Delete and Index	Import	Sort	Search	Delete and Index
R:BASE 3.0	1821	3855	4	5	174	169	5	4
Paradox 3.0	1540	2082	14	2741	161	142	18	195
R:BASE for DOS	1224	2791	2	1590	120	137	2	51

CONTINUES ON PAGE 43

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CIRCLE 181 ON READER SERVICE CARD

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Use it at office or home. Run the latest multi-tasking applications under Windows® or Northgate's OS/2®. Crunch numbers on the biggest spread sheets. Sort, search and select data in your databases at the blink of an eye. Use it as a file server, and if you're looking for high performance terminals in a network environment, SlimLine 320 is an ideal solution.

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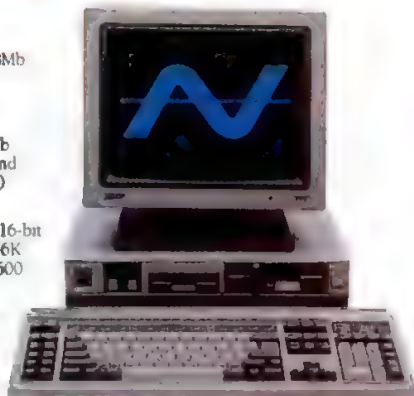
December 26, 1989



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- Intel 80386-20MHz microprocessor
- 2Mb of RAM; expandable to 8Mb on motherboard
- 40Mb hard drive with 28ms access time
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- Page mode memory system
- Integrated high performance 16-bit VGA color controller with 256K video RAM supporting 800x600 line resolution
- Integrated high performance floppy and hard disk controller on the motherboard
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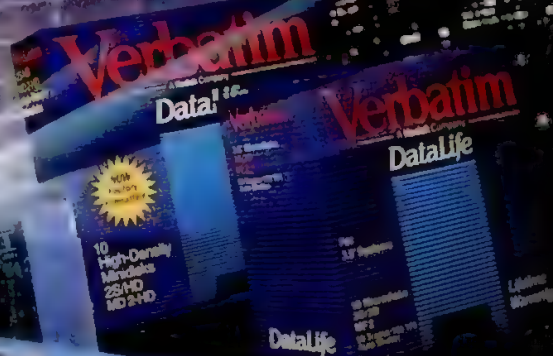
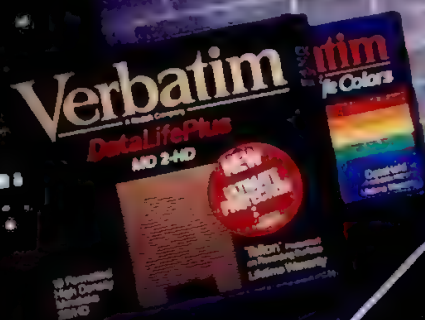


P.O. Box 41000 Minneapolis, Minnesota 55441

"We hear you!"

*PC Magazine December 26, 1989 reviewed the Northgate MicroStation 386/20. This system has been upgraded and is now named the "SlimLine 320."

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Doing More For The Data Process

First Looks

R:BASE 3.0

CONTINUED FROM PAGE 38

lational operations without knowing SQL. You can use INSERT to add rows of one table or view to another, JOIN two tables to create a new one, INTERSECT and UNION to combine tables that have a common column, or use SUBTRACT to retrieve the set of rows that differ in one table from another.

On the programming front, *R:BASE* offers several new commands and functions, and embedded SQL has been tightly integrated into the *R:BASE* programming language. The latter makes it easy to rely on SQL for data retrieval and manipulation; the command language continues to control the interface and drive the application. While these facilities are well worth having, they're not without a small price. Existing databases and applications have to be converted to run under *R:BASE* 3.0. However, conversion facilities

Sort	Edit	Calculate	Layout	Query	Relation view	Print	Exit
Single column							
Multicolumn sort							
List							
Clear sort							
7	5-AL-HAT						
8	5-AL-HAT						
9	5-AL-HAT						
10	5-AL-HAT						
11	15-ST-CO						
12	15-ST-CO						
13	15-ST-CO						
14	15-ST-CO						
15	15-ST-CO-89						
16	20-BU-COM-90						
17	20-BU-COM-90						
18	20-BU-COM-90						
19	20-BU-COM-90						
20	20-BU-COM-90						

R:BASE 3.0's table-management features offer full-screen table editing, with pull-down menus and pop-up boxes.

for both are supplied.

In general, *R:BASE* 3.0's performance is not as good as *R:BASE* for DOS. On the PC Labs benchmark tests, the IMPORT test ran 30 percent slower and the SORT test ran 18 to 27 percent slower than it did under *R:BASE* for DOS. While the percentage difference in the SEARCH tests for the two

DBMSs was large, the SEARCH benchmark test still completed in only a few seconds on either database. Finally, *R:BASE* 3.0's support for relational VIEWS allows it to dramatically reduce the time required for the DELETE columns test. Since the purpose of this benchmark test is to check a DBMS's ability to ac-

cess a subset of table columns as a table in its own right, *R:BASE* 3.0 used a VIEW to cut this task's time to a few seconds.

Since *R:BASE* 3.0 fully integrates ANSI SQL and embraces the relational database model, developers should take a good look at *R:BASE* when planning new applications. That, along with its improved interface and expanded output facilities should make it more appealing to end users, too.



FACT FILE

R:BASE 3.0

Microm, 3925 159th Ave. NE, Redmond, WA 98052; (206) 885-2000

List Price: \$795

Requires: 640K RAM, 6.5MB of hard disk space, DOS 3.1 or later

In Short: A powerful, full-featured relational DBMS with tightly integrated SQL, a robust programming language, easy-to-use interface, multiuser auto-refresh, and QBE. Should be considered by all developers.

CIRCLE 447 ON READER SERVICE CARD

Premier 210: PC with Sound Chip Is a Good Value for Visually Handicapped



The visually handicapped have some very sophisticated options to help them use a computer—provided they have an unlimited budget.

But Premier Innovations—a new manufacturer of PCs from Dallas—has introduced a machine that will appeal to the visually handicapped and fall well within the reach of typical corporate budgets.

The Premier 210 uses an Oki sound synthesizer to recite DOS error messages in clear speech—without the aid of any extra hardware. Better yet, the error messages are translated into polite English, so that instead of droning "Bad command or filename," the 210 properly articulates the message, "I cannot find that file" if it's a mistyped filename that's

causing the problem, or says, "I do not recognize that command," if the problem is with the command syntax. The Premier 210's sound chip is addressed as a device driver, so standard DOS redirection works with text files.

About 600 error messages are recorded in ROM; for the most part, the vocals are very clear. Less articulate is the synthesis of readings from text files. You can copy any text file into the sound system files, and the machine will make its best attempt to read the words aloud. Although the words may not always be clear, good sense has been used in writing the parser, so numbers and delimiters are often treated correctly.

The Premier 210 is an otherwise unspectacular 16-MHz 286 machine; it has five slots and presents a small footprint. It's backed by TRW on-site ser-

vice, so it's not a high-risk machine.

And as far as innovations go, the Premier 210 makes one of the most original uses of a 286

chip we've seen at *PC Magazine* in years.

List Price: Premier 210, \$1,395 with 1.4MB floppy drive; \$1,889 with 40MB hard disk. Premier Innovations, 10310 Harwin Dr., Houston, TX 77036; (800) 347-1777.

CIRCLE 432 ON READER SERVICE CARD

The Premier 210 uses an Oki sound synthesizer to recite DOS error messages.



First Looks

COBOL Development Tool Lets Programmers Write PM, DOS, And Mainframe Applications

HANDS ON
by Andrew Topper

For COBOL programmers, gaining the proficiency in C to develop applications for the OS/2 Presentation Manager means a significant investment of time. Now, there's less reason to switch to a new language. Micro Focus has cut down the need for extensive retraining by providing support for the OS/2 Presentation Manager Application Program Interface (API) in its COBOL/2 set of products.

What's the connection between COBOL, a first-generation language, and the OS/2 Presentation Manager? The COBOL 85 standard, which is fully supported by COBOL/2, handles many of the data types and control concepts required in PM applications.

Version 2.4, the latest release of COBOL/2, offers a batch of new features, among them enhanced PM support for COBOL, extended memory support for DOS, a report writer, embedded SQL execution from within COBOL, multiple-thread support within OS/2, and Animator support under PM.

The COBOL/2 compiler costs \$900; the Toolset, \$900; and the Workbench, \$1,800.

The COBOL/2 language handles recursion, local data storage, non-COBOL calling conventions, parameter passing by value, receiving values from external routines (or the operating system), pointer data types, and the assigning of addresses of functions or procedures to variables. Not only does the new version accommodate multiple threads, it handles long filenames (up to 64 characters), bit manipulations, and provides a utility for converting C header files for OS/2 into COBOL formatted files. Other features include COBOL Source Information (CSI), which organizes and identifies dead code and indicates how programs are structured; Fileshare, a transaction logging and recovery file server for client/server applications; and Co-Writer, a screen and report painter.

SQL support in COBOL/2 allows developers to execute SQL commands for DB2, XDB, OS/2 Extended Edition, and SQLBASE from within their COBOL programs. The Anima-

tor, COBOL/2's interactive debugger, now lets you debug PM applications in one screen group under OS/2 while the application executes in another screen group. Thus, developers who have two monitors can debug their PM applications and control the input/output to their programs separate from the debugging tool.

PANELS, an API for SAA/Common User Access (CUA) applications that is callable from COBOL/2, supports mouse input, dialog boxes, menus, and scrollable text. Applications that use PANELS can execute under DOS or PM or in OS/2 character mode—without your having to change the source code in the application. Since COBOL/2 is IBM platform independent, you can create applications that will run on DOS- or OS/2-based PCs, AIX-based machines, and System/370s, all from within a single development environment.

The COBOL/2 Workbench runs in a text window under PM, and is best used in full-screen mode. It lets you compile, edit, and debug (Animate) at the same time under OS/2 (using multiple threads). The Workbench also offers concurrent execution under DOS.

COBOL/2's integrated environment will help newcomers get acquainted with the program quickly. From the Workbench menu, the product's editor, checker, compiler, Animator, and utility functions are just a keystroke away. (If you're using OS/2 1.1, a bug in that version of the operating system prevents the COBOL/2 Workbench from displaying the Alt and Ctrl menu options in a full-screen window; OS/2 1.2 remedies this problem.)

The Workbench offers online help, a complement to the massive documentation that comes with COBOL/2. Also, excellent sample programs, each of which are extensively documented and include descriptions of the concepts used, serve as models for imitation. A PM calculator program makes use of all the major PM calls. This program includes sample resources (windows, dialog boxes, etc.), accelerator keys,



FACT FILE

COBOL/2, Version 2.4

Micro Focus, 2465 E. Bayshore Rd., #400, Palo Alto, CA 94303; (415) 856-4161.

List Price: COBOL/2 compiler, \$900; COBOL/2 Toolset, \$900; COBOL/2 Workbench, \$1,800; all three products, \$3,290.

Requires: DOS version: 2MB RAM, hard disk, DOS 3.3 or later; OS/2 version: 6MB RAM, 9MB of available disk space, OS/2 1.1 or later.

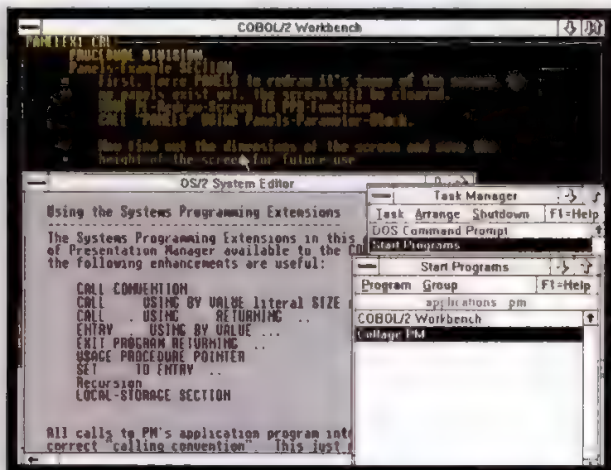
In Short: A complete PM applications development environment with an interactive debugger (Animator), an editor, source code utilities, SQL support, and a screen/report painter. Handles multiple threads, long filenames, bit manipulations, and includes a utility for converting C header files for OS/2 into COBOL formatted files. Can be used for creating DOS and OS/2 applications as well as for off-loading mainframe applications development onto the PC.

CIRCLE 441 ON READER SERVICE CARD

child windows, and a standard client window procedure. COBOL/2 also comes with a document that describes in detail the extensions made to COBOL to support PM.

Still, learning how to program for the OS/2 Presentation Manager will take some time, regardless of which programming language you use. As they would with any windowing operating system, COBOL programs that run under OS/2 PM must respond to asynchronous messages and must be structured quite differently than traditional COBOL programs.

Micro Focus has made practical the concept of off-loading applications development in COBOL from mainframes to PCs. For developers who are thinking about writing applications for the OS/2 Presentation Manager, Micro Focus COBOL/2 is an excellent alternative to C or Assembler. For those who need to develop SAA/CUA-compliant applications using COBOL, Micro Focus COBOL/2 is the only real option available for PCs. And for everyone else who programs in COBOL, this development tool is a tour de force. ■



Here, a COBOL program is being edited in the COBOL/2 Workbench editor (full-screen window), and a document file is being edited in the OS/2 System Editor (small window).

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First Looks

PC Tools Deluxe 6.0: Jack-of-All-Utilities Crams Even More into One Package

HANDS ON
By Edward Mendelson

With the release of Version 6.0 of *PC Tools Deluxe*, Central Point Software continues its relentless quest to include every known utility in a single package. If you use all of this \$149 omnium-gatherum, it can fill almost 3MB of your hard disk. In return it gives you functions that might fill your whole disk if you used separate programs.

In addition to enhanced versions of its DOS shell and file manager, disk and desktop utilities, the package now includes an integrated version of *Lap-Link* and direct support for CAS-compatible fax boards. The miniature database is *dBASE*-compatible, and the calculators match HP's advanced models. I couldn't find a 3-D spreadsheet or a desktop publishing module, but perhaps I didn't look hard enough.

The busy-looking mouse-compatible interface is more customizable than before. The file manager now includes an optional DOS command line and fast-acting file viewers that display formatted text. You can make the directory screen default to a convenient three-window screen with a tree, a file list, and a viewer screen.

Because you can automatically launch an application associated with a file viewer, you can press a key while viewing a spreadsheet and load it into *Lotus 1-2-3*, then exit and launch *WordPerfect* while viewing the next file. You can do all this while running the shell in resident mode over your database.

The backup program adds speed and options, and now writes directly to standard Mountain, CMS, and Archive tape drives. Results in informal testing with a Mountain drive were faster than with Mountain's own software. The rewritten cache program now caches

writes for faster performance, but misguidedly lets you set it to wait up to 14 seconds before writing to disk. For safety, choose immediate writes.

A new Diskfix utility, resembling *The Norton Utilities'* Disk Doctor, can restore damaged directories, FATs, and boot sectors. It needs some fine-tuning. When I blanked out part of the boot sector on one of my DOS 4.01 partitions, Diskfix first told me I was probably using non-DOS partitioning software, then refused to do anything to help. *The Mace*

Utilities' Emergency Room restored the partition in seconds.

A package this gigantic inevitably has other minor bugs. If you install on a drive other than C:, for example, the communications module looks for files on drive C: anyway. And the shell has the annoying habit of starting up on the same drive every time unless you specify a drive letter at the command line. If you want the shell to start up on the current drive, use the undocumented trick of changing byte 4F in the PCSHELL.CFG file to 00h.

List Price: *PC Tools Deluxe*, Version 6.0, \$149; upgrade \$30. **Requires:** 512K RAM, DOS 3.0 or later; hard disk recommended. Central Point Software, 1520 NW Greenbriar Pkwy., Beaverton, OR 97006; (503) 690-8090.

CIRCLE 481 ON READER SERVICE CARD

Time Line 4.0 Adds Presentation Graphics, Mouse Support

HANDS ON
By Henry Ford

Symantec's *Time Line* has always been well regarded for offering an easy-to-use interface and an extremely thoughtful set of project management features. Version 4.0 improves on this tradition. *Time Line* now incorporates presentation graphics, which used to be a separate \$195 program, and has full

mouse support.

In addition, you now can edit task data directly in the Gantt chart, build extensive macros, draw both outline and traditional PERT charts, automate the WBS structure to suit your design, do resource leveling within slack, and enter resource allocation in hours. For these additional features *Time Line* costs \$695, \$100 more than Version 3.0.



Time Line 4.0 can display as many as five resource histograms at the bottom of the Gantt chart screen.

To add graphics to *Time Line*, Symantec didn't just throw in its old *Time Line Graphics* program. Instead, the company spent two years writing a totally new set of facilities that give the program true presentation-quality charts. You can control the font size of letterforms; use proportional spacing; choose colors for every aspect of a chart, including the background; use rounded corners; change line thickness; customize the titles and legend; annotate the chart; and use special symbol sets.

Although *Time Line* is still a character-based program, you can see a WYSIWYG preview of your output before you print, and zoom in on a section to see it in detail. Charts can be scaled manually up or down in size to change awkward page breaks, or they can be forced to one page. Symantec has also rewritten *Time Line's* printer drivers; the program includes drivers for PostScript printers, and devices for producing 35mm slides, color overheads, and transparencies.

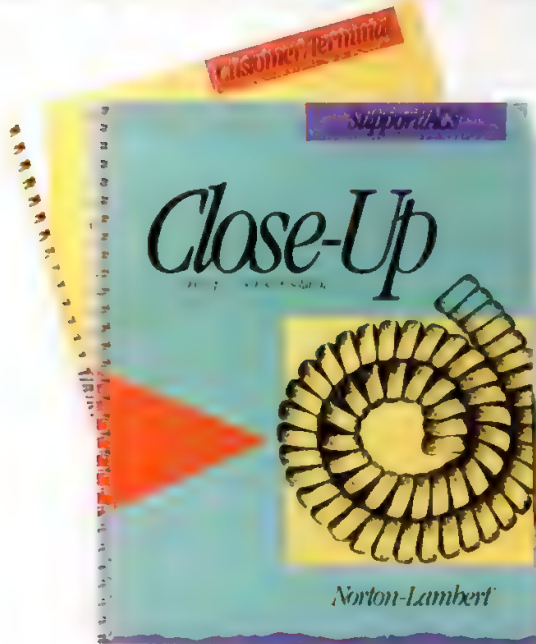
Time Line's mouse support and its ability to accommodate editing in the Gantt chart (its most important project view) make the product even easier to use. Two macros for quickly generating a schedule and graphic output come with the package, as do libraries of preformatted Gantt chart layouts, filters and color palettes.

Several other new features, such as the WBS Manager, the enriched import/export facilities and cross-project task linking, let you integrate project data with other applications and distribute project control for a network. All these new additions help *Time Line* 4.0 maintain its preeminent position in the low-end project management field.

List Price: *Time Line* 4.0, \$695; upgrade from *Time Line* 3.0, \$149 (through June 30); upgrade from *Time Line* 3.0 with *Time Line Graphics*, \$99 (through June 30). **Requires:** 640K RAM, hard disk, DOS 3.0 or later. Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; (408) 253-9600.

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Close-Up handles all your communication needs. That's why we're #1.



Close-Up/LAN: The Network Remote

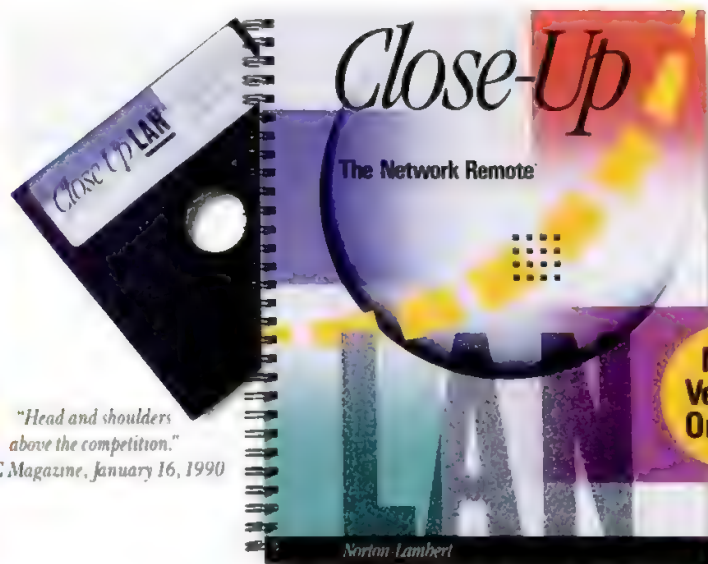
Winner of the highest award, PC Magazine "Editors' Choice", Close-Up/LAN connects people on a network. Giving you the power to share screens and keyboards with one, many or all PCs on your network. At the touch of a key. Without leaving your word processor, spreadsheet, or other software.

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First Looks

Memory Managers for Everything from XT's to 486s



Now that most computers incorporate expanded and extended memory in addition to the high memory just north of DOS, users have a dizzying variety of RAM to manage. Merrill & Bryan's \$99.95 *Turbo EMS*, Version 5.0, and Invisible Software's \$59 *Invisible RAM 386*, Version 2.0, are recent entries in a field of memory managers dominated by *QEMM-386* and *386MAX* for 386 and 486 computers, and by *QRAM* and *Move'EM* for lesser machines.

Turbo EMS provides memory managers for all kinds of computers in a single package. Unlike other memory managers that only convert extended memory into LIM expanded memory, *Turbo EMS* can also transform disk space into up to 32K of simulated LIM memory. You can combine disk-based and RAM-based expanded memory, and the program automatically uses the fast RAM before swapping to the disk.

In systems that already have a LIM 4.0 expanded memory board, or any 386 system, *Turbo EMS*, like many other memory managers, lets you load device drivers and TSRs into high memory so that they take away nothing from DOS. On a 286 or better, *Turbo EMS* occupies only a mere 2K of DOS RAM. But, with a bare 8088, or any machine that lacks extended memory, *Turbo EMS* needs 34K of DOS RAM.

If you don't need to use disk space as LIM memory, you can duplicate the functions of *Turbo EMS* more conveniently in other packages. *Turbo EMS*, for example, won't let you use expanded memory with device drivers loaded in CONFIG.SYS, which means that you can't place a RAM disk in expanded memory. It won't let you use more than one region of

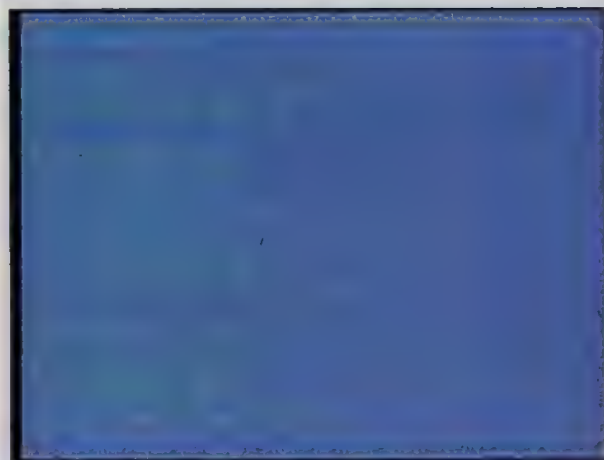
high memory for TSRs.

Its high-memory loading function is fussy about syntax in ways that the manual doesn't specify. Until tech support explained that I had to omit the .COM or .EXE extensions from the names of programs that I tried to load in high memory, *Turbo EMS* kept spewing out error messages saying it couldn't find programs that were exactly where I said they were.

Turbo EMS's configuration



Turbo EMS lets you configure the entire program from a menu that includes detailed explanatory notes.



Invisible RAM 386 offers information about memory usage on demand, but doesn't tell you where your programs are.

file is incomprehensible to anyone outside tech support, and changes that expert users make by hand to their CONFIG.SYS settings can lead to baffling lockups. Most users will have to shuffle between at least two of the three separate manuals before configuring the program successfully.

Invisible RAM 386, as the name implies, manages RAM only on 386 or 486 machines. Like its better-known counterparts, *QEMM-386* and *386MAX*, the program converts extended memory into LIM 4.0 expanded memory and also allows you to put TSRs and device drivers in high memory. It lacks such frills as utilities that help you optimize your use of high memory or *QEMM*'s ability

to load FILES and LAST-DRIVE into high memory.

You do get some highly technical frills that you won't find elsewhere. For example, you can set the size of the DMA data buffer for each of the seven DMA channels on standard-bus computers and the eight channels of MCA machines.

This option could conceivably help you optimize your memory usage if you know the details of the data transfer capacities of your hard disk and tape drive. Even *QEMM* only lets you set a single size for the DMA buffer. Technically expert users can specify virtually any option for expanded memory, including the number of register sets, page frames, and handles.

Though packed with options, *Invisible RAM 386* handles memory less efficiently than *QEMM* and *386MAX*. A set of TSRs and device drivers that load easily into high memory using those programs fit only partially using *Invisible RAM 386*. And when *Invisible RAM 386* can't load a TSR in high memory, it doesn't load it at all, unlike *QEMM* and *386MAX*, which sensibly load it into low memory. One TSR, the LaserMaster printer driver, consistently locked up when loaded high under *Invisible RAM 386*.

Neither *Invisible RAM 386* nor *Turbo EMS* has utilities that describe which programs are loaded into high memory, and advanced users may feel they're flying blind when they use these packages. Both are inexpensive alternative routes to memory management. But the more expensive routes may prove to be more economical. ■

List Price: *Turbo EMS*, \$99.95. **Requires:** 256K RAM, DOS 2.1 or later. Merrill & Bryan, 9770 Carroll Center Rd., #C, San Diego, CA 92126; (619) 689-8611.

CIRCLE 448 ON READER SERVICE CARD

List Price: *Invisible RAM 386*, \$59. **Requires:** 80386, 80386SX, or 80486; 2MB RAM, DOS 3.0 or later. Invisible Software Inc., 1165 Chess Dr., #D, Foster City, CA 94404; (415) 570-5967.

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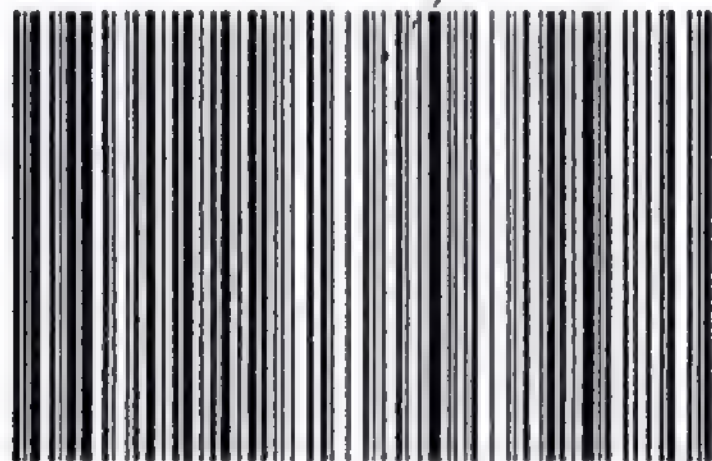
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1. Follow instructions on the other side

Back

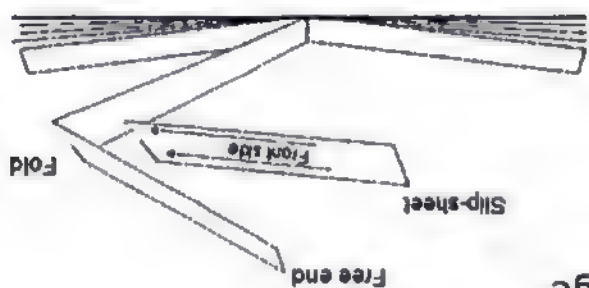
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Inverted Back

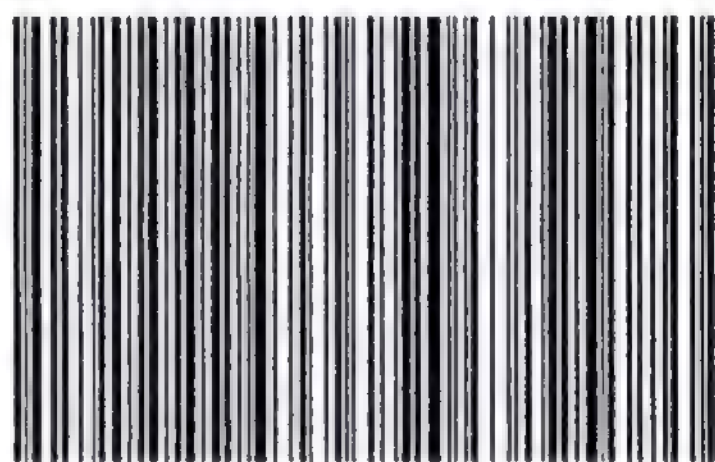
1. Follow instructions on the other side

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 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



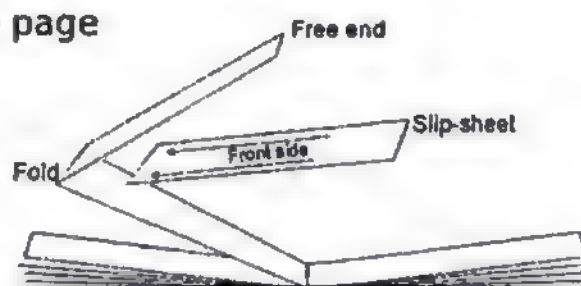
Foldout slip-sheet

Folded edge of the page



Inverted Foldout slip-sheet

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First Looks

When DOS Is Not Enough, Three Command Enhancers Offer Options

HANDS ON
by Edward Mendelson

Microsoft should study *4DOS* to find out how *COMMAND.COM* should have been written. On second thought, perhaps Microsoft should stay away from JP Software's \$50 replacement for *COMMAND.COM*. Its programmers might find *4DOS* too embarrassing to look at.

4DOS lets you do everything DOS should let you do but doesn't, and gives you up to 4K extra RAM as a bonus. With *4DOS*, you enter the same DOS commands you already know, but you can also use entirely new commands. One is a full-fledged *HELP* that explains all other commands, including new ones that set screen colors, execute a command in all directories or on all files except the one specified. You also get long-needed options with familiar commands, like switches for *DEL* and *COPY* that let you confirm deletions, or copy only newer files over older ones.

Like other command-line enhancers, *4DOS* lets you edit the command line and review or reuse earlier commands. But because *4DOS* replaces *COMMAND.COM* you don't have to expend RAM on a program that enhances *COMMAND.COM*.

Like *PCED*, *4DOS* lets you write elaborate "aliases"—commands that combine multiple commands under one name or that let you rename any command. *4DOS*'s aliases don't have all the frills of *PCED*'s, but *4DOS* also supports batch files that, unlike DOS's, run entirely from RAM and don't read each line from the disk. *4DOS*'s batch processor lets you draw boxes and lines, and allows delays, beeps, and other enhancements normally available only with separate add-ons.

You load *4DOS* by adding a "shell" statement to *CONFIG.SYS* that specifies *4DOS*



4DOS's help function explains DOS commands and *4DOS* commands. Notice the added parameters for *DEL*.

.COM as your command processor. The DOS system files remain untouched. *4DOS* works with any PC, but 286- and 386-based systems save RAM by loading part of *4DOS* into extended memory.

4DOS's authors claim 99 percent compatibility with *COMMAND.COM*, but you may encounter some problems, especially with multitaskers and networks. Workarounds make you sacrifice some RAM normally saved by using *4DOS*. Programs that shell to DOS by invoking *COMMAND.COM* won't shell to *4DOS*. You can get around the problem by renaming *4DOS.COM* to *COMMAND.COM*, but the manual advises against it.

PCED has no compatibility problems, more flexible aliases, and adds screen scroll-back and other functions, but uses more RAM (or high RAM) and leaves you with many of *COMMAND.COM*'s limitations. *4DOS* is a unique achievement, but the more advanced you are as a DOS user, the more patience you'll need to tailor *4DOS* in order to make the best of it.

Two other command-line enhancers, Sunburst Development Corp.'s \$29.95 *Command*

Manager and Moderne Software's \$25 *Anarkey*, also deserve consideration. Both let you recover and edit existing commands, even from earlier sessions. Both load in high RAM. The more limited *Command Manager* is designed for use by anyone, while *Anarkey* is best suited for advanced users.

Command Manager can automatically save your commands to disk and recover them

again in the next session. You can set it so that you edit the DOS command line with the same keystrokes you use in *WordPerfect*.

Anarkey lets you enter multiple commands on one line, and supports aliases. You can type the first few letters of a command or parameter, then press the tab key, and let *Anarkey* cycle through all the filenames that might complete the command. *Anarkey*'s command completion is even more flexible than *PCED*'s.

Whichever command enhancer you choose, choose one. DOS is not enough. ■

List Price: *4DOS*, Version 3.0, \$50 (includes 1 upgrade); also available as shareware.

Requires: 128K RAM, DOS 2.0 or later. JP Software, P.O. Box 1470, East Arlington, MA 02174; (617) 646-3975.

CIRCLE 442 ON READER SERVICE CARD

List Price: *Command Manager*, \$29.95. **Requires:** 9K RAM, DOS 2.0 or later. Sunburst Development Corp., P.O. Box 10, Provo, UT 86403; (801) 374-5223.

CIRCLE 443 ON READER SERVICE CARD

List Price: *Anarkey*, \$25, plus \$3 for shipping; also available as shareware. **Requires:** 10K RAM, DOS 2.0 or later. Moderne Software, P.O. Box 3638, Santa Clara, CA 95055; (408) 247-0509.

CIRCLE 444 ON READER SERVICE CARD



Anarkey comes with a menu-driven program that lets you redefine its default function and cursor movement keys. This is the first of four screens.

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- 1.2MB OR 1.44MB FLOPPY DRIVE
- 101-KEY TACTILE FEEDBACK KEYBOARD
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- REAL-TIME CLOCK/CALENDAR AND BATTERY
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- AMI BIOS
- ZERO WAIT STATE MEMORY ACCESS
- 384K SHADOW RAM
- 1:1 INTERLEAVE FLOPPY/HARD DISK CONTROLLER
- 1.2MB OR 1.44MB FLOPPY DRIVE
- 101-KEY TACTILE FEEDBACK KEYBOARD
- 2 SERIAL PORTS, 1 PARALLEL PORT AND 1 GAME PORT
- 8 EXPANSION SLOTS
- KEYBOARD SELECTABLE CPU SPEED
- REAL-TIME CLOCK/CALENDAR AND BATTERY
- SUPPORTS INTEL 80387 & WEITEK 3167 CO-PROCESSORS
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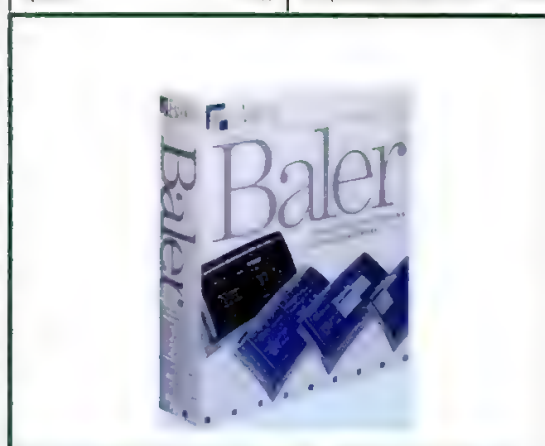
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Baler 5.0 is a spreadsheet compiler that allows you to build customized programs from Lotus 1-2-3 files (.wk1). In moments you can take your template and build it into a standalone program with 80 new features from Baler. You can build pull down menus, pop up macros and create up to 1500 pages of context sensitive help screens. \$359.

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by
Matthew J. Ross

New & Improved

News of Announced Products and Upgrades

Tektronix Lowers Ante for Color PostScript Printing

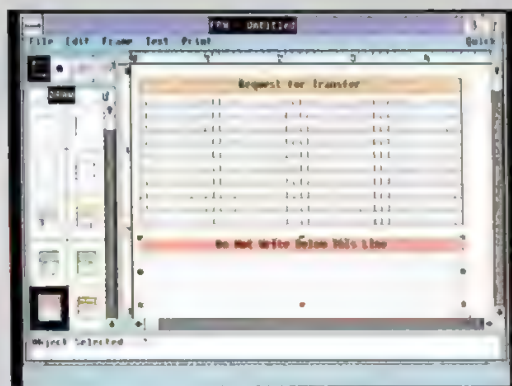
NEW

Targeting the growing segment of networked and mixed-platform environments, the \$7,995 Tektronix Phaser PX includes serial, parallel, and AppleTalk ports with automatic switching across the three. The printer uses thermal wax transfer technology and outputs at a resolution of 300 dots per inch.

In addition to PostScript, the Phaser PX supports HPGL and can dynamically switch between the two emulations. In its standard configuration the Phaser PX features 6MB of memory (expandable to 10MB), a PostScript-language controller with a 16-MHz Motorola 68020 processor, and 35 resident fonts. Download support is provided for Adobe Type 1 and Type 3 formats. The Phaser PX also includes SCSI support for an optional hard disk for font caching that will be supported in a future release of the system's software. Furthermore Tektronix will upgrade any existing color thermal wax transfer printer to the PX's capabilities for \$3,995.

List Price: Tektronix Phaser PX, \$7,995, 4MB memory upgrade, \$1,495. Tektronix Graphics Printing and Imaging Division, P.O. Box 1000, MS 63-630, Wilsonville, OR 97070; (800) 835-6100.

CIRCLE 436 ON READER SERVICE CARD



Form Publisher for Windows takes an object-oriented approach to forms creation.

WYSIWYG Forms Package for Windows

NEW

To create professional-quality forms, **FormWorx** has designed *Form Publisher for Windows*, Microsoft Windows-based forms-creation software that uses an object-oriented design approach. Users select "building blocks" of frequently used elements such as address labels from an object library.

Form Publisher's allows users to create or import logos, signatures, and other graphics,

and place them anywhere on the form. The package supports .TIF, .PCX, and .MPS file formats and includes Forms-On-Demand, a library of 550 standard government, industry, and business forms on disk. *Form Publisher* has built-in scanner support with low- and high-resolution preview modes, as well as HP Direct (FormWorx's own driver for HP LaserJet printers), which the manufacturer claims reduces printing time considerably.

List Price: Form Publisher, \$249. **Requires:** 640K RAM, Microsoft Windows/286 or Windows/386, Version 2.0 or later, DOS 3.0 or later. FormWorx Corp., Reservoir

Pl., 1601 Trapelo Rd., Waltham, MA 02154; (617) 890-4499.

CIRCLE 435 ON READER SERVICE CARD

Utility Quartet Aids Financial Calculations

NEW

If you're trying to figure out the payments on a new car loan or a home mortgage, pop up **Timeslips Corp.**'s memory-resident utility *PercentEdge*, which is specifically designed for solving monetary transactions over time. *PercentEdge* is actually four separate utilities for financial analysis: amortizations, mortgages, present-value calculations, and variable rate transactions. Predefined templates and on-line help are included to solve complicated financial calculations. Users can create "what-if" scenarios by simultaneously comparing multiple examples on-screen. *PercentEdge* also features a pop-up calendar and calculator for use with the financial utilities. Each utility takes only 7K of conventional memory, and files that are created in *PercentEdge* can be exported to most spreadsheets and databases.

List Price: *PercentEdge*, \$99.95. **Requires:** 7K RAM, a hard disk or 320K expanded memory, DOS 2.1 or later. Timeslips Corp., 239 Western Ave., Essex, MA 01929; (800) 338-5314, (508) 768-6100.

CIRCLE 436 ON READER SERVICE CARD

HOT PROSPECT

SQLLINK UTILITY LINKS WINDOWS DDE AND SQL SERVER

Developed in conjunction with Bumblebee Software's *dbfast/Windows* dBASE-language compiler, **SQLSoft's** *SQLLink for Microsoft Windows* links applications that support *Microsoft Windows* Dynamic Data Exchange (DDE) to *Microsoft SQL Server*. The program works with most *Windows* applications that support DDE, including *Microsoft Word for Windows*, *Microsoft Excel*, and *dbfast/Windows*.

The *SQLLink* kernel consists of five mandatory DDE commands which establish the DDE link with *SQL Server*, verify the contact, send variables, request results from *SQL Server*, and terminate the link.

List Price: *SQLLink for Microsoft Windows*, \$149.95 per workstation. **Requires:** 7K RAM, *Microsoft Windows/286* or *Windows/386*, Version 2.11, *Microsoft LAN Manager*, Version 1.1, *Microsoft SQL Server*, DOS 3.0 or later. SQLSoft, 45 Front St. South, #B, Issaquah, WA 98027; (206) 391-5099.

CIRCLE 433 ON READER SERVICE CARD

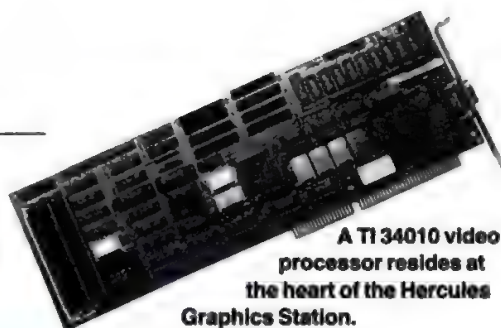
New & Improved

Hercules Card Combines 8514/A, TIGA Standards

NEW

Running the gamut of high-resolution graphics standards, **Hercules Computer Technology's** latest video adapter outputs at a resolution of 1024 by 768 with 256 simultaneous colors, in both non-interlaced and 8514/A-standard interlaced. In addition, the card features a 24-bit Super Precision Color mode with a resolution of 512 by 480 resolution and over 220,000 simultaneous colors.

The Hercules Graphics Station Card has a Texas Instruments 34010 processor and supports the TIGA graphics standard. It comes with 1MB of RAM, expandable to 2MB, outputs analog video via a standard 15-pin connector, and fits in a single 16-bit expansion slot.



A TI 34010 video processor resides at the heart of the Hercules Graphics Station.

List Price: Hercules Graphics Station Card, \$1,024. Hercules Computer Technology Inc., 921 Parker St., Berkeley, CA 94710; (415) 540-6000.

CIRCLE 440 ON READER SERVICE CARD

DBMS Add-on Facilitates Data Analysis

NEW

To help speed analysis of information derived from databases, **Marathon Systems** has created *Colorcube*, a low-cost software package

that takes information extracted from your DBMS (database management system), adds color based upon the relative value or rank of the cell, and displays the results in a row-column matrix. The user determines color selection, and a maximum of 20 colors is possible, allowing for a different color for each five percent variance in a given set of values.

List Price: *Colorcube*, \$79.95. **Requires:** 512K RAM, DOS 2.0 or later. **Marathon Systems**, 478 W. Hamilton Ave., #165, Campbell, CA 95008; (408) 448-5325.

CIRCLE 438 ON READER SERVICE CARD



Colorcube helps you analyze patterns and trends in your DBMS's numerical data.

IMPROVED

Force, Version 2.0—Sophco has enhanced its dBASE-language compiler that creates TSR applications. According to the company, the added NetBIOS support provides familiar *Clipper*- and *FoxBASE*-like networking, as well as advanced dBASE, *FoxBASE*, and *Clipper*-aware record locking. *Force* 2.0's network communications system informs you when a locked record becomes available. It also creates a processing environment that permits distribution of the workload across several network nodes. *Force* 2.0's other improvements include up to 255 open files, interrupt processing via "On Key" support, private variables, a save/restore screen to and from private variables, and C programming language library compatibility. *Force* 2.0 retails for \$695 with upgrades for registered users available for \$75. Sophco Inc., Boulder, Colo.; (800) 922-3001, (303) 444-1542.

DesignCAD 3-D, Version 3.0—American Small Business Computers has improved the BasicCAD programming language in its three-dimensional computer-aided design package to include: Arithmetic Assignment, String Assignment, external procedure calls written in other programming languages, and a full range of mathematics and trigonometric functions. The ability to key in formulas as well as values whenever *DesignCAD 3-D* asks for a number has been added. Other new features include Rubber-Band Orthogonal Line, a Wall command for architects, three

new circle commands, and five arc commands. Version 3.0 of *DesignCAD 3-D* retails for \$399 with upgrades available to registered users for \$40. American Small Business Computers Inc., Pryor, Okla.; (918) 825-4844.

Budget Express, Version 1.1—Symantec's *Lotus 1-2-3* add-in now supports all the new features of Release 2.2, including full compatibility with the *Allways* print functions. Users can now view and print detailed budget and summary reports from the same spreadsheet. Version 1.1 supports a network feature that permits users to create and modify consolidation procedures for joining dissimilar spreadsheets across a network. File preservation and locking have also been added. A goal tracking scoreboard allows for "what if" scenarios while making changes in a spreadsheet, and the UNDO feature in 1-2-3 Release 2.2 is now supported. *Budget Express*, Version 1.1, costs \$149. Upgrades are available for \$24.95 by contacting the Symantec Customer Service Department at (800) 441-7234, or (800) 626-8847 inside California. Symantec Corp., Cupertino, Calif.; (408) 253-9600.



DesignCAD 3-D lets you rotate and shade three-dimensional objects.

WordPerfect Office Editor, Office, Version 3.0—in response to the large demand for an enhanced macro editor to support *WordPerfect* 5.1 macros, WordPerfect Corp. is offering its macro editor as a separate product

CONTINUES ON PAGE 56

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New&Improved

IMPROVED

CONTINUED FROM PAGE 54

prior to the release of *WordPerfect Office 3.0*. *Editor 3.0* supports *WordPerfect 5.0*, *5.1*, *PlanPerfect 5.0*, and *Shell 3.0* macros. The update of *WordPerfect Office* includes support for multiple servers, gateway services, and remote communications. Wide Area Network and Novell MHS gateway support has been included. *WordPerfect Office Editor 3.0* is now available directly from the company for \$45. *Editor 3.0* will be included in the forthcoming *Version 3.0* of *WordPerfect Office*. It will retail for \$149 as a standalone product; network versions will also be available beginning at \$695 for a five-user multipack. WordPerfect Corp., Orem, Utah; (800) 321-4566, (801) 225-5000.

Superbase 4, Version 1.2—This update supports the new release of *Microsoft Windows* while still maintaining compatibility with *Windows 2.x*. *Superbase 4* auto-senses the correct *Windows* version and configures itself automatically. Users can now select multiple files in a single operation, and scroll bars have been added to long text field edit boxes for easier viewing. Database enhancements include the ability to create unindexed files, improved indexing algorithms and support of integer and long numbers. Graphic support includes encapsulated PostScript files and video resolution up to 1,024 by 768 pixels. *Superbase 4* now takes advantage of dynamic link libraries (DLLs). Precision Software plans to add direct SQL database update and query support in the fall. *Superbase 4* retails for \$695. Upgrades to Version 1.2 will be distributed free of charge to all registered users. Precision Software, Irving, Tex.; (214) 929-4888.

Easy Order Professional Series, Version 5.0—MicroTyme Network has updated its order fulfillment software to include support of inventory import and export, laser printer support for mailing labels, separate printer ports for invoices and labels, and the ability to produce UPS Manifest printouts. Additional features include expansion of the number of line items per order from 6 to 32 lines, network support up to 10 workstations and a new database designed by TurboPower Corp., which MicroTyme claims will significantly improve performance. *Easy Order Professional Series 5.0* retails for \$189 or \$288 with the Inventory Add-On Module. MicroTyme Network Inc., Garland, Tex.; (800) 423-6837, (214) 840-9313.

Tree86, Cache86—Version 3.2 of The Aldridge Co.'s file-management package runs in 5K of conventional memory using memory swapping and can recognize hard drives of almost any size. Users can perform text searches on tagged files and eliminate entire subdirectories with the Kill Directory command. Network support has been added so that *Tree86* can read 16,000 files per drive, up to a maximum of 26 drives. *Cache86* has been optimized to utilize expanded memory while using only 1K RAM. *Cache86* now runs in extended memory with a cache size of up to 3MB, or it can use conventional memory to create a cache of up to 512K. *Tree86*, Version 3.2, retails for \$89.95; registered users may upgrade their package for \$19.95 plus \$3 shipping. *Cache86* retails for \$49.95, with upgrades available for \$9.95. The Aldridge Co., Houston, Tex.; (713) 953-1940.

Micrografx Structured Graphics Toolkit, Version 3.6—Micrografx has released a set of dynamic link libraries (DLLs) containing 400 graphic functions to simplify programming graphics applications for *Microsoft Windows*. Included as an add-on is the *Intelligent Font Driver*, which offers font scaling and permits fonts from different vendors to be mixed within the same document. Additional features include style control of line joins, end caps, and line widths; improved Bezier curve manipulation; word processing and desktop publishing text features; better group control of multiple objects; and Virtual Memory and Virtual Bitmap managers to provide transparent swapping of global data to extended or LIM EMS 4.0 memory. Also, a new Micrografx Bitmap Filter can read and write device-independent TIFF and .PCX files. Licensing fees for the *Micrografx Structured Graphics Toolkit* generally begin at \$10,000 with price reductions available for internal development. Micrografx Inc., Richardson, Tex.; (800) 272-3729, (214) 234-1769.

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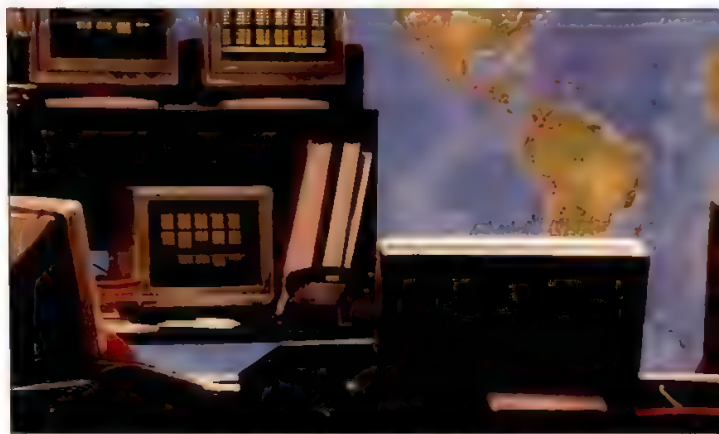
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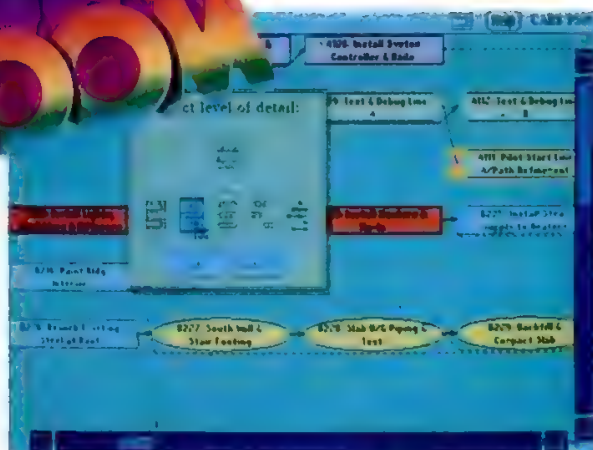


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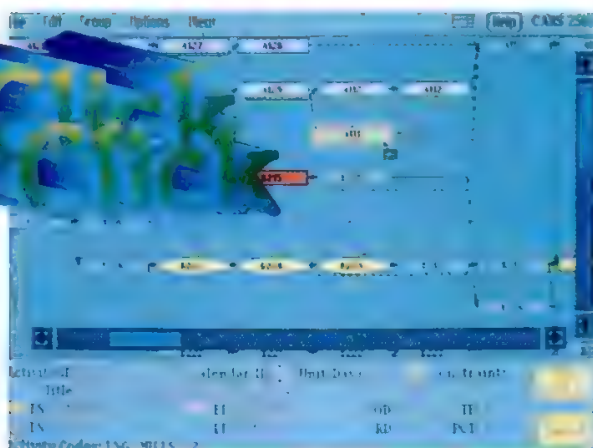
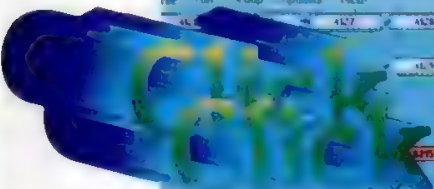
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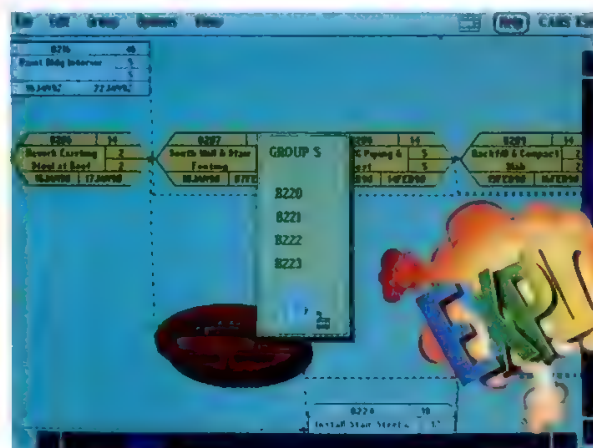
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List Price: *FileRoom*, \$99. **Requires:** 640K RAM; Hercules, EGA, or VGA monitor, DOS 3.0 or later. Deerfield Systems Inc., 221 Elizabeth St., Utica, NY 13501; (315) 797-1805.

CIRCLE 439 ON READER SERVICE CARD

Desktop Optical Jukebox Holds 6.5 Gigabytes

NEW

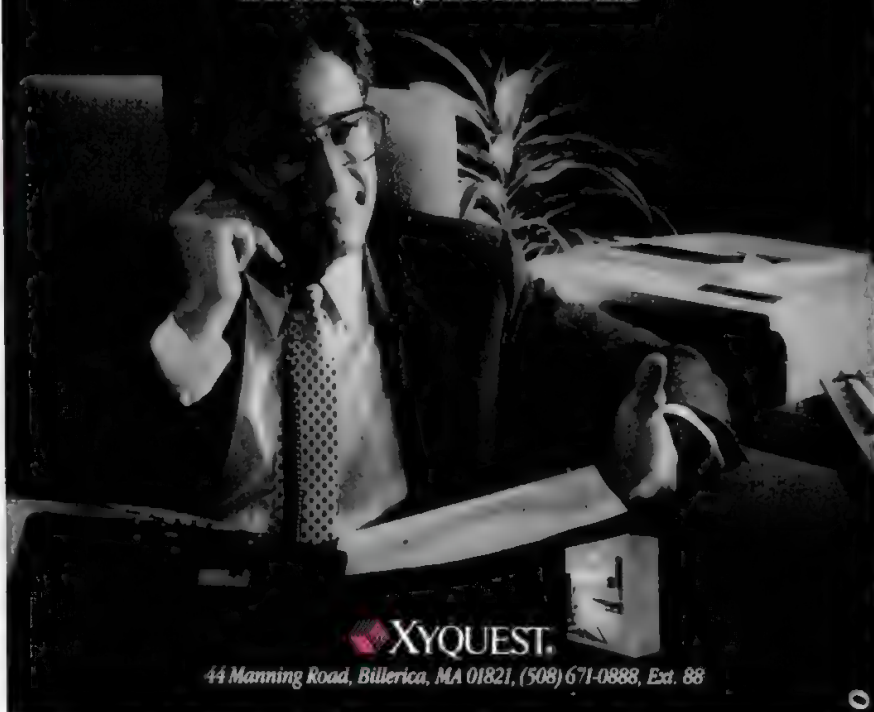
Pinnacle Micro's REO-6500 desktop optical disk jukebox holds as many as ten optical-erasable disk cartridges for up to 6.5 gigabytes of unformatted disk capacity. The ten disks can be addressed as individual volumes or as one continuous volume. A robotic arm mechanism retrieves the proper disk cartridge with disk changes taking between 6 and 12 seconds. The REO-6500 features a SCSI interface, measures 12 by 12.25 by 18.75 inches (HWD) and weighs 45 pounds. Interface kits are available for IBM and compatible PCs, the Macintosh, and Sun and DEC workstations.

List Price: REO-6500, \$9,995; JPAK Personality Adapter Kit, \$995; compact disk media cartridges, \$250. Pinnacle Micro Inc., 15265 Alton Pkwy., Irvine, CA 92718; (800) 553-7070, (714) 727-3300.

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CIRCLE 518 ON READER SERVICE CARD

Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

Computers certified by the FCC as meeting the Class B standard are less likely to cause interference to radio and TV reception than those that have been verified by the manufacturer or importer to the Class A standards. Only Class B certified computers may be advertised, sold, or leased for use in residences. A similar regulatory program applies in Canada.

Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

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- Optional 16-MHz 386SX Module \$395
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FCC Class B

Sure it's a great computer, but can it dance?

Admittedly, the **ALR PowerFlex** has several of the same features that you'd like to see in your daughter's prom date.

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Yes, the ALR PowerFlex is just what you're looking for if you need a new PC for a growing business, a home office, or a corporate network. But no matter how much you like the PowerFlex or how

versatile this system is, tradition specifies that your daughter's prom date should be, well, at least allegedly human. Still, keep this consoling fact in mind. With the money that you save purchasing (and upgrading) the PowerFlex, you'll be able to buy your daughter a beautiful prom dress, rent a very nice limousine, and give her enough money to cover dinner when her date forgets his wallet.

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CIRCLE 165 ON READER SERVICE CARD

edited by
Lori Grunin

Read Only

Reviews of the Latest Books for the PC User

Observing the Protocols

■ *Desktop Communications: IBM PC, PS/2 & Compatibles*

by David A. Honig and Kenton A. Hoover
John Wiley & Sons, \$22.95

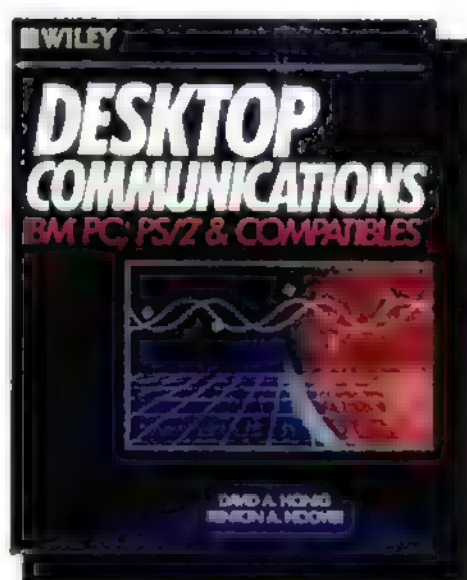
For Honig and Hoover, the term *communications* not only means PCs talking to each other but also involves aspects of local and internal communications. *Desktop Communications: IBM PC, PS/2 & Compatibles* explains how the PC communicates with its different components when it receives information such as keyboard input, or how data is sent to a local printer. It also covers the computer's communication with a variety of devices, such as modems, printers and other computers, both PCs and mainframes.

The authors begin with the terminology used in PC communications. The chapters that follow help the reader understand the differences between RS-232 serial (as well as other serial modes) and Centronics parallel-communication ports, and how each is used.

They cover the difference between synchronous and asynchronous types of communications and transferring files from one computer to another. What protocols are and the different protocols used for file transfer are clearly defined.

The book also introduces you to the various network operating systems and topologies, and offers some general guidance on how to decide which network will most closely suit your needs.

Did you ever hear those sounds that the modem makes when dialing out, and wonder what they mean? The book



Desktop Communications helps unravel the mysteries of data transfer.

explains those and also describes the modem's components and how information is translated from computer signals to telephone signals.

Examples were easy to follow and understand. They repeat definitions in different chapters, obviating the need to interrupt your reading flow to go back and reread a definition. The authors offer explanations for the beginner early in the book, noting the importance of a concept, then follow up with more-detailed examples later.

The book is a good reference on desktop communications, accurate and easy to follow, with photographs of equipment and detailed diagrams to help explain ideas to the nontechnical reader. It's certainly a useful source of information for anyone who works with PC-based data communications or for anyone interested in learning about it.

—Joseph F. Rizzo

John Wiley & Sons, Business/Law/General Books Division, 605 Third Ave., New York, NY 10158; (212) 850-6000. ISBN: 0-471-60613-8.

CIRCLE 406 ON READER SERVICE CARD

The Littlest HP

■ *DeskJet Unlimited*

by Steve Cummings
Peachpit Press, \$21.95

The uninitiated will puzzle over the existence of a book like *DeskJet Unlimited*. Does the world need a 428-page guide to a printer? Why not a book for every dot matrix device ever put on the market?

Most DeskJet owners will understand. This innovative inkjet is a rare breed. Quasi-LaserJet compatible, it has inspired its own dedicated newsletter and is one of the few printers whose characters will dissolve when moistened.

HP's manual is heavy on configuring the printer with other HP products, and too terse to be much help with anything but the most basic problems.

Steve Cummings' breezy approach makes *DeskJet Unlimited* informative reading for the sort of owner who bought the printer for



modest desktop publishing. There's good basic information about using programs like *WordPerfect*, *WordStar*, and *Microsoft Word*, but unfortunately the book doesn't go beyond using soft fonts and setting up a printer driver.

I didn't find anything here that made me change the way I use my DeskJet, but I would recommend the book to anyone who's bought a DeskJet and hasn't a clue about how to get good-looking pages out of it.

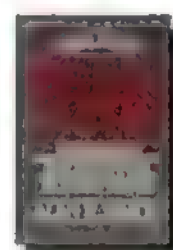
—Gus Venditto
Peachpit Press, 1085 Keith Ave., Berkeley, CA 94708; (415) 527-8555. ISBN: 0-938151-11-8.

CIRCLE 407 ON READER SERVICE CARD

Striking Out on Your Own

■ *How to Be a Successful Computer Consultant, Second Ed.*

by Alan R. Simon
McGraw-Hill, \$29.95 hardbound,
\$19.95 paper



Do you secretly long for the freedom and financial rewards enjoyed by computer consultants? If so, look

first at *How to Become a Successful Computer Consultant* by Alan R. Simon. It covers a range of important topics, including how to develop a specialty, how to set rates, and how to decide if you are cut out for the rigors of the trade. While he glosses over many topics, Simon does guide you toward more-detailed resources.

The author has an easy-to-read style, but the book's tone verges on Pollyanna's optimism. For instance, in the sample cash flow projection for the new business, Simon assumes that 70 percent of all billable work will be paid for in an average of 15 days—60 days is more typical. And who can get a business phone installed for just \$10 a month with no installation fee?

Still, there is enough useful information in this book to rely on it as a guide to the initial planning stages. Resolving the issues it raises won't guarantee your success but will steer you clear of many of the pitfalls awaiting you in your quest for profitable independence.

—Alfred Poor

McGraw-Hill Publishing Co., 1221 Avenue of the Americas, New York, NY 10020; (800) 2-MCGRAW. ISBN: 0-07-057554-1.

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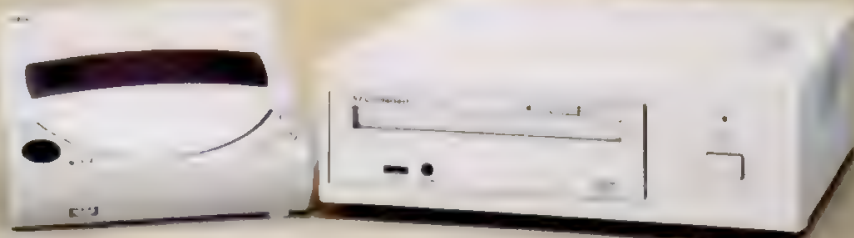


competitive prices possible. And CDP backs it all with helpful advice, expert technical support and prompt service including overnight shipping at your request. Now with three special offers, we're bringing it all together and putting more information at your fingertips for less!

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Whether you need CD-ROM capability at home, in the office, or on the road, NEC's speedy, reliable Intersect CD-ROM kits are the perfect answer. With shorter seek times and blazingly fast data transfer rates, these readers make accessing software faster and easier than any others in their class. And they're versatile enough to be used with DOS or Macintosh platforms. The portable CDR-35 Drive Kit (\$798.00 List) features a reader that weighs just 2.2 pounds. Yet it's anything but a lightweight. It gives you full CD-ROM capabilities at about half the price of desk top CD-ROM readers. With the optional rechargeable battery pack, the CDR-35

has the power to go wherever you go. And it's versatile enough to read both 3" and 5" CD-ROM's. The Intersect CDR-72 Drive Kit (\$1,098.00 List) is NEC's top-of-the-line model. A third generation workhorse that features a high-speed SCSI interface, 350 MS access time, 150 KB data transfer rate and a 64K data buffer for added performance. The CDR-72 is available in half height internal and desktop external models and comes with an industry standard data cartridge and a switchable power supply. And now CDP bundles either kit with today's most popular CD-ROM software.



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by
Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

Windows 3.0 Perfects the Graphic Interface, Closes the Gap with OS/2

You'll have to forgive those arguing that *Microsoft Windows* has been holding up the acceptance of OS/2 if they're acting smug these days. When the new *Windows* upgrade reaches PCs in the coming weeks, the casual user won't even be able to tell the two environments apart.

Microsoft Windows 3.0 closes

a development cycle that started in April 1987 when IBM called the graphical version of OS/2 the Presentation Manager and continued with Microsoft's use of the label for *Windows 2.01*.

Windows 3.0 catches up to OS/2's interface to achieve a visual parity that's likely to last for a long time.

All of the icon-based graphics of OS/2 1.1 are copied by *Microsoft Windows 3.0*. The File Manager and Program Manager used in OS/2 1.1 are replicated, and even the use of Ctrl-Esc as a task switcher that throws you out to DOS is parroted by *Windows 3.0*.

The new *Windows* won't multitask or run OS/2 programs, but in every other way, *Windows 3.0* gives you the benefits of OS/2's look-and-click environment.

The program was slated for a May 22 unveiling—too late to allow a *PC Magazine* hands-on

First Look to be published in this issue (it should appear next issue)—but hundreds of independent software developers have been chomping at the bit with new programs for months now.

Microsoft had hoped to release the program in late '89 and has been enthusiastically encouraging new *Windows* development all along.

Those new programs will be necessary if *Windows 3.0* is to continue the growth curve that *Windows/286* and *Windows/386* have started. The real magic of *Windows 3.0* is its use of pro-

CONTINUES ON PAGE 64

TOP TEN SELLERS — A First-Week Ranking

QEMM-386 is proving that its recent success is not a fluke; after recovering from an exhausted supply, Quarterdeck has returned its multitasking program manager to the top spot again. Meanwhile *Microsoft Windows/286* was ranked at number 12.

Breaking into the Top Ten list for the first time is Borland's upgrade package for *Quattro Pro*. It offers Lotus users a chance to buy *Quattro Pro* at a discount, if they mail in a page from their 1-2-3 manual.

QEMM-386 5.0
Quarterdeck Office Systems

WordPerfect 5.1
WordPerfect Corp.

PC Tools Deluxe 6.0
Central Point Software

**Norton Utilities
Advanced Edition, 4.5**
Peter Norton Computing

Quicken 3.0
Intuit

Fastback Plus 2.1
Fifth Generation System

Lotus 1-2-3 2.2
Lotus Development Corp.

ProComm Plus 1.1B
Datastorm Technologies

dBASE IV 1.01
Ashton-Tate Corp.

10 Quattro Competitive Upgrade
Borland International

READING THE CHART

The Top Ten Sellers list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending April 21. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of March 19. Dramatic shifts in a particular program's ranking may be the result of sales promotions conducted by individual retailers. Seasonal factors, such as end-of-year budget purchase decisions, can also play a large role in the performance of a particular program in any period. More than 12,000 individual locations contribute to the list.

Sales information compiled by Ingram-Micro D and PC Connection Inc.

Rankings are based on a net total of copies shipped; returns are subtracted from gross shipments.

Pipeline

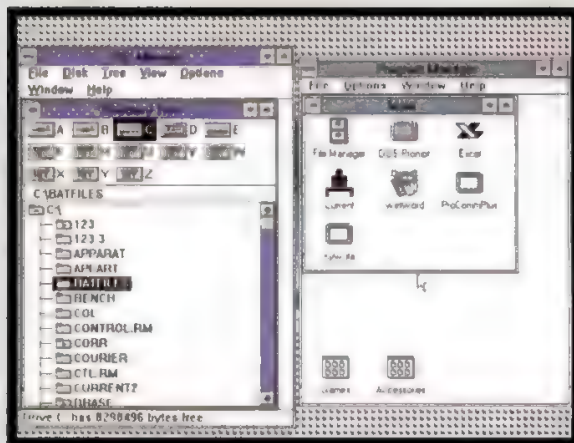
CONTINUED FROM PAGE 63

ected mode (sorry, 8088s). *Windows* 3.0 sessions can use all the available RAM in a 286, 386, or 486 PC up to 16MB; there's not even a 640K limit on each session.

The drawback is that just about all of today's *Windows* applications need to be modified to run in protected mode. Although Microsoft has said "well-behaved programs"—meaning those that followed all of Microsoft's specifications for using *Windows* program services—will run in the protected mode, even *Microsoft Excel* needs to be upgraded (although Microsoft began quietly shipping a *Windows* 3.0-compatible upgrade early this year). The only *Windows* application now shipping (that I know about) that runs well in protected mode (aside from those late-model *Excels*) is *Microsoft Word for Windows*.

That's not a complete obstacle to *Windows* 3.0 use. There's a real mode switch (simply run the WIN.COM program with a "/R" option) that runs the old applications just fine and still gives you the new interface: you simply lose out on the greater-than-640K memory space.

You still gain Mac-like icons that load applications with a double-click (you can assign an icon to any DOS application with a simple selection of the New Program Item option from the Program Manager's main menu).



Windows 3.0 comes with both the File Manager and Program Manager that were introduced in OS/2 1.1. Icons represent applications; if they run under *Windows*, the Program Manager displays a unique symbol for the application. DOS programs are identified with generic icons. At the bottom right of the screen, note the program group icons, which represent any subset of applications that you choose.

You can also gain Program Groups that let you organize your applications into coherent folders without back-slashing your way through subdirectories.

Windows 3.0 is likely to have a major impact on the different kinds of software being developed. It has had developers in a quandary for several years now: given limited resources, which platforms do they choose? DOS has a market but there's little uncharted ground: the 640K limit arrives too quickly. *Windows* seemed like a way station on the road to OS/2 one year ago; now that stopover is looking like a permanent vacation.

A few years from now, *Windows* 3.0 will probably be looked on as the program that really got everyone ready for OS/2. Its wide-open address space will encourage people to get more RAM, preparing their machines for bigger applications; and its nimble graphical menus will entice still more users into the complex world of multiple sessions.

And it will be an ideal sampler for the direction that Microsoft is taking for PCs—if you don't like *Windows* 3.0, you'll never be happy with OS/2.

The key question now is whether or not a perfected

Windows can win the hearts and minds of those millions of users who've ignored *Windows* in favor of multitasking schemes like *Software Carousel* and *DESQview* or who've never tried anything to manage their workday applications.

The odds are in Microsoft's favor for the simple reason that no other plausible strategy exists for helping DOS applications evolve. And since Microsoft plans to give *Windows* the ability to run directly under OS/2 2.0 by next year, the likelihood of *Windows* and OS/2 dominating the desktop are absolutely overwhelming.

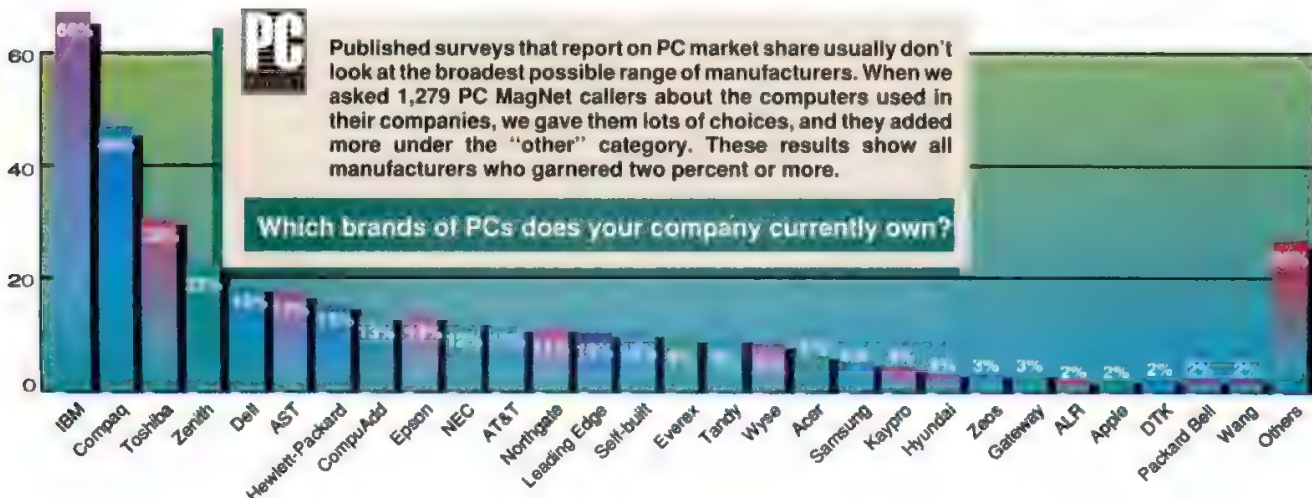
Compaq Agrees to Run the Gauntlet for LAN Manager

Two weeks after the Novell-Lotus merger was announced, Microsoft succeeded in enlisting the help of Compaq in selling *LAN Manager*.

3Com has been unable to gather much support in a year of marketing for the OS/2-based network system, so Microsoft is now turning to PC manufacturers for help.

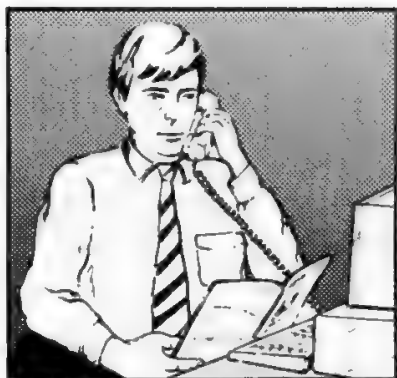
Compaq is only the first in what Microsoft hopes will be a long list of PC companies to sell and support the system.

Buying the network operating system from your computer vendor is one way of assuring compatibility between the network and the hardware. Novell, on the other hand, maintains an ambitious broad-based certification program that guarantees compatibility between hardware, software and *NetWare*. ■



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Confidence



In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

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- Does the seller have formal return and refund policies?
- Is there an additional charge for use of credit cards?
- Are credit card charges held until time of shipment?
- What are shipping costs for items ordered?

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

- State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.
- Establish that the item is in stock and confirm shipping date.
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- Obtain an order number and identification of the sales representative.
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If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

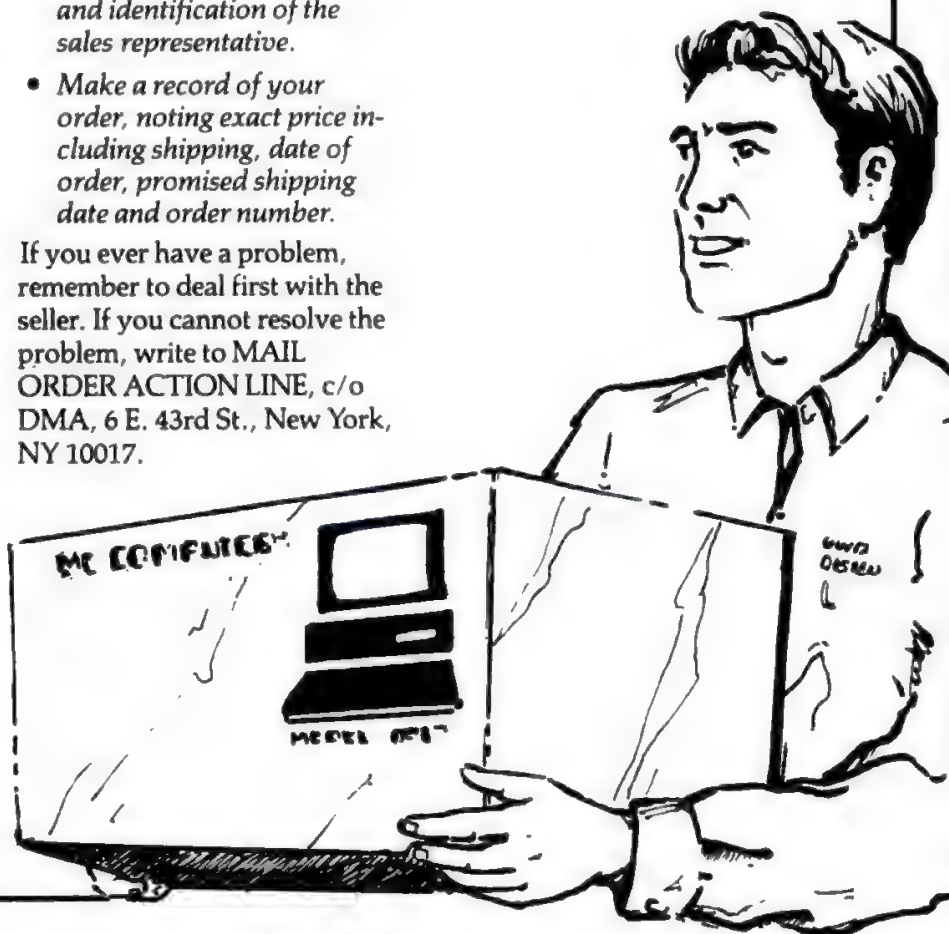
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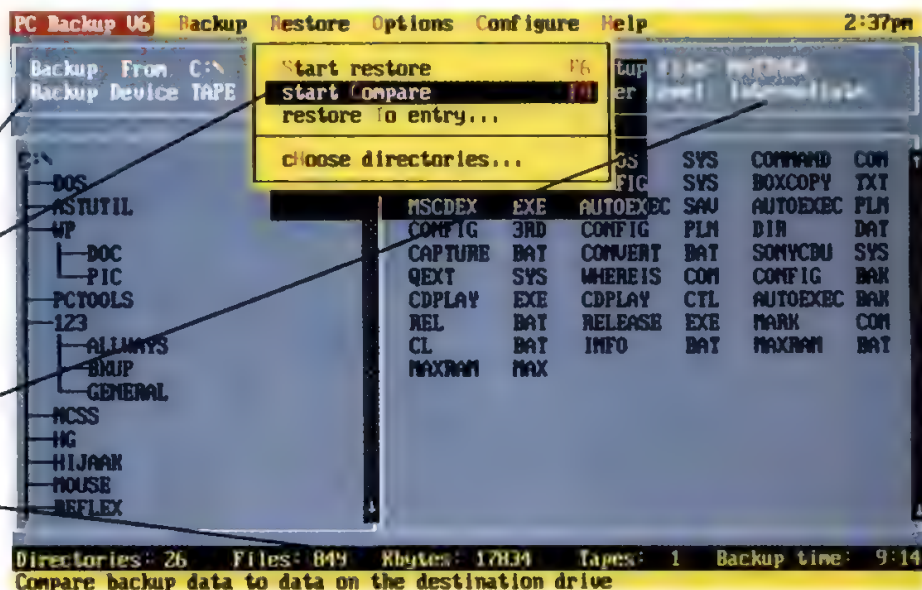
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— InfoWorld, May 8, 1989

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— PC Magazine, Jan. 16, 1990

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- NEW** Over 30 file viewers let you browse through an entire directory of files in a matter of seconds.
- NEW** Resident DOS prompt. Hot-key into PC Shell and execute any DOS command without leaving your main program.

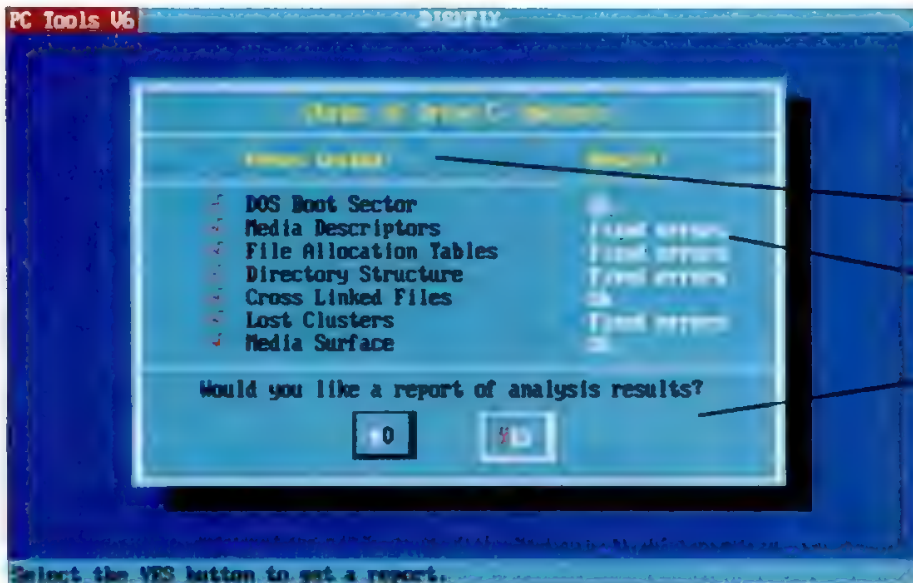


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This year we're proud to announce PC Tools Version 6: over 70 new features that set new standards for technical excellence

ough for advanced users h for beginners."

Ed Mendelson, PC Magazine "Best of 1989 Awards," January 16, 1990



Data Recovery

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— InfoWorld, Dec. 18, 1989

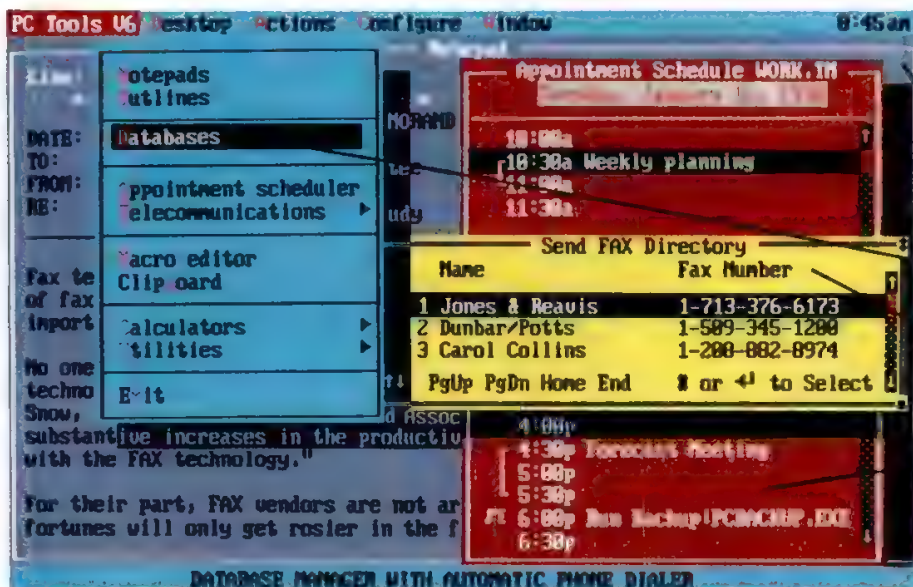
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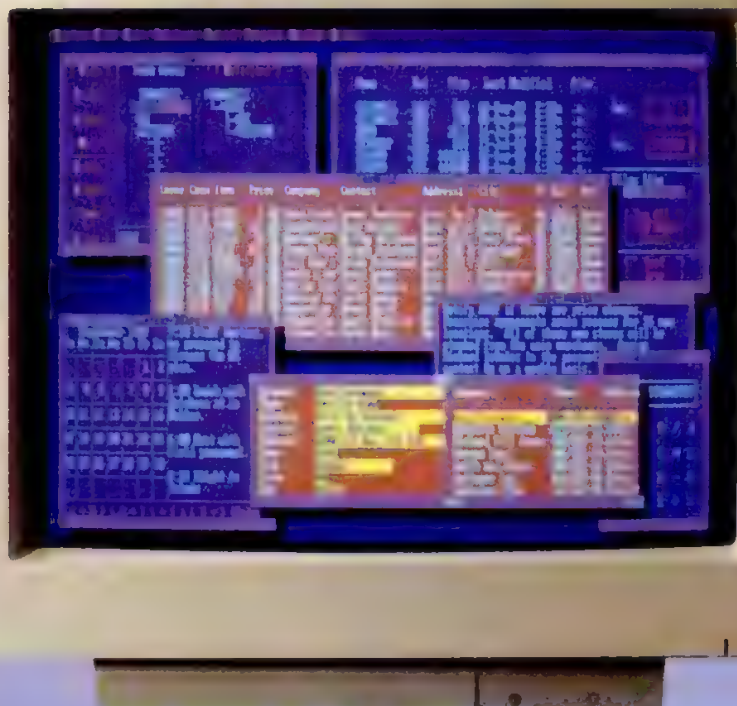
New FoxPro

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Bill Machrone



Who Calls The Shots?

What are your equipment-buying criteria? You and your boss may be seriously out of sync.

Top management doesn't read *PC Magazine*. That's the conclusion I'm forced to draw after observing a bunch of Fortune 1000 MIS (Management Information Systems) executives from behind the mirrored wall of a focus group room. Not only do they not read it, but they generally don't pay any attention to products you use every day on the desktop.

Granted, they've got bigger things to worry about. Mainframes and minicomputers are still with us in a big way, at a big price tag. It takes top-level strategy to make sure your company gets the right stuff. All this long-

range planning and dealing with the board of directors has its price. In fact, I've come to the startling and obvious conclusion that top MIS people are no more mainframe-proficient

than PC-proficient. They may have started in mainframes, and to the extent that many fundamentals haven't changed, their knowledge is still valid. But the growth areas in mainframes (advanced databases, connectivity, 4GLs, etc.) are just as foreign to them as your hard disk controller.

We're to blame, too. *PC Magazine* doesn't have much in it to interest them. Not only are they appalled by the sheer size of *PC Magazine*, but by the information density and the bewildering array of brands and models. Some of them cope with the onslaught by denial: they simply ignore the existence of anything but IBM. They justify this by claiming that nothing else is *really* compatible with IBM; this statement by one of them drew head-nodding agreement around the table in one of our sessions. They further claimed that their shops were pure IBM.

This, of course, directly contravenes what we know: Compaq does more than half of its business with the Fortune 500; Dell, 25 percent. Could we have lucked into dozens of sites that were True Blue? When pressed on the issue, a few of the executives admitted to some lesser brands being present, "but we don't allow them to be connected to our mainframes."

We saw some differences between the East and West coasts. The West Coast companies were smaller, younger, and more tolerant of compatibles. We also found some high-level managers of PCs who reported to end-user departments, not MIS. The PC managers and the MIS'ers had little to say to one another.

All of our MIS attendees admitted that end-user computing was essentially out of control, that departments controlled their own budgets, and therefore their hardware selections. Most of the purchase requests flowed through the MIS department on the way to Purchasing, but the VPs never looked at them unless they departed radically from company practice. Later, they admitted that they really had no idea how many PCs they had or what brands.

PCs AREN'T COOL

You can't assemble dozens of MIS directors on both coasts without finding a few PC enthusiasts. Once they caught the drift of the group, however, they toned down their enthusiasm and suppressed their technical knowledge. It's hard for me to imagine someone aspiring to *less* knowledge, but that was the drift.

Of course, they didn't know that *PC Magazine* was the sponsor of the sessions, and the



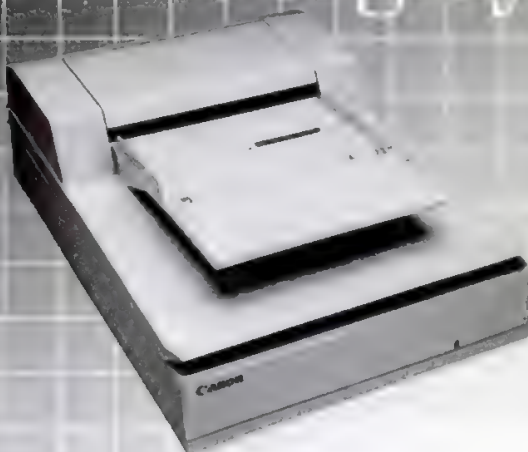
ILLUSTRATION: SHANNON JEFFRIES

moderator didn't give any clues in the far-ranging, open-ended questions. So we were pleasantly surprised when some of them mentioned *PC Magazine* in describing the tools they used to stay current with technology. When they did, however, the rest of the group regarded them with some suspicion.

I had trouble reconciling what they said they were responsible for with what they did and

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Bill Machrone

how they went about it. They claimed to know and control everything PC-related and to keep up-to-date on PC product developments. But their single concern was with standardization. Technological improvements seemed of little interest.

On the software side, the conservatism evidenced in these groups would have caused the most stalwart software marketer to seek more gainful employment. One of these people said that her department's biggest project of the moment was a time-consuming evaluation of *WordPerfect* 5.1 in order to decide whether it was worth upgrading from 5.0. She was pretty advanced. The rest were just beginning to question whether *MultiMate* was still the state of the art. None appeared to have the slightest interest in the wrenching shifts in technology or price/performance.

UPHILL STRUGGLE

I have an ongoing worry that people with power but without knowledge may make decisions for PC users. These focus groups did a great deal to ease my mind. In fact, the groups vehemently agreed that if manufacturers want to sell something to their companies that they should talk to the user departments. They figure it's the users' jobs to make a business case for a brand other than the entrenched standard. The MIS'ers stated pretty clearly that while they might *accept* brands other than IBM, they would never *choose* them.

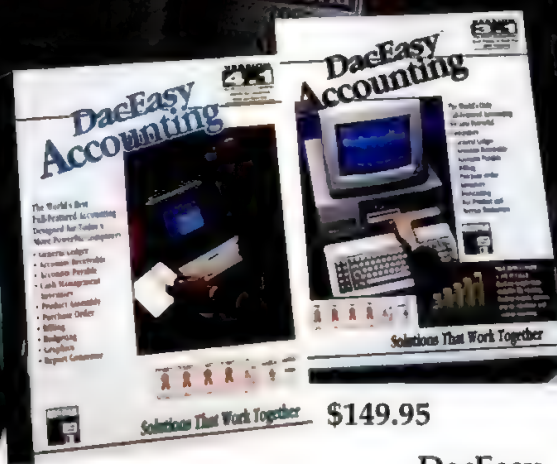
Since your boss doesn't have a thorough grounding in the issues you deal with day in and day out, communication is bound to be difficult. Your boss won't have experienced the weirdnesses of PS/2 memory expansion, the hassles of early Compaq power supplies, and the host of other experiences that make up your personal computer knowledge base.

If your boss isn't PC literate, you've got an uphill struggle on your hands. I don't fault any of the executives for attitudes that might strike some as head-in-the-sand. Data processing is a rigorous discipline. You learn early on to go with what works and not to take chances. So when you make your next presentation, bear that in mind. Minimize your boss's (and company's) risk and you'll make real progress.

Does your boss read *PC Magazine*? Mine does. But he's an exception. ■

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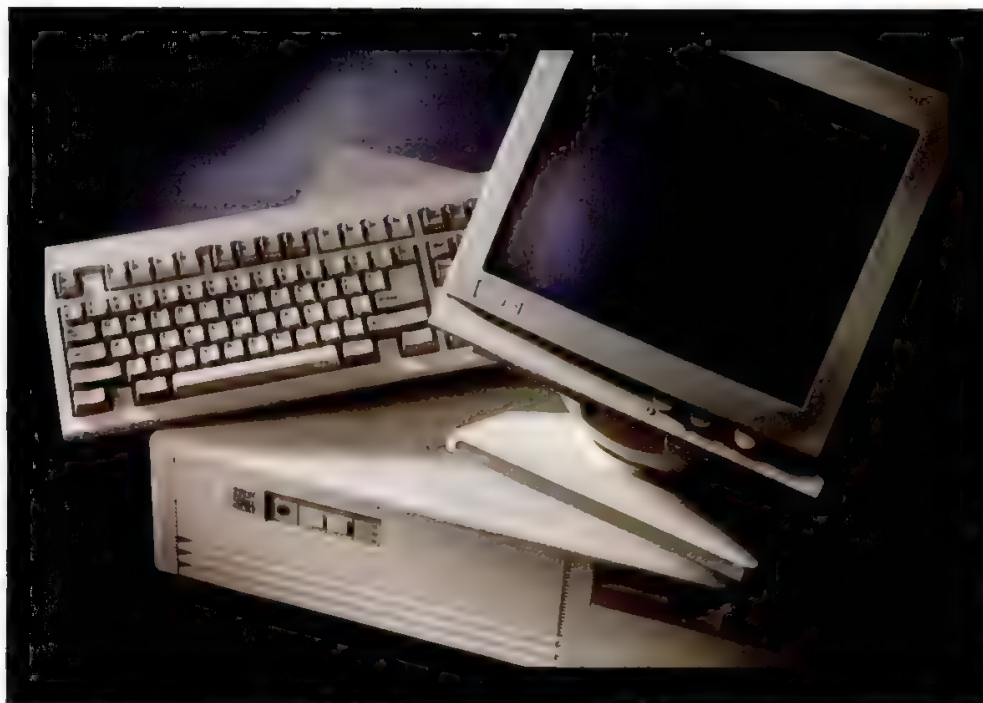
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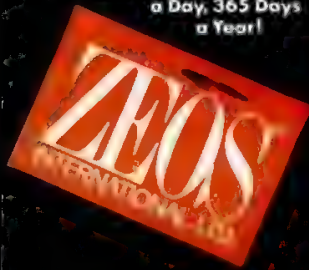
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John C. Dvorak



It's Time E-Mail Standardized Worldwide

A standard addressing scheme will help e-mail put fax back into the museum where it belongs.

It's time to standardize e-mail addressing schemes. There is a movement afoot to do so, but it's up to computer users to support the concept and vote for e-mail by using it.

I don't know how often I have to recount the sad tale of how dead-end facsimile technology went from being a laughingstock to an overnight sensation because of the sudden standardization of fax parameters and protocols. Group III fax took a stagnant technology and made it the most important form of electronic communications in the world. Its power

almost toppled the Chinese government. For a moment the fax was mightier than the sword. Unfortunately, it wasn't mightier than a Chinese Army tank.

Promoters of electronic messaging all know that fax pales in comparison to the potential of e-mail. E-mail should be the leader, but it has no standards. More important,

there is no official e-mail addressing scheme. The closest thing to a standard is called the Domain Naming System (DNS), used by Bitnet and Internet. A new international standard dubbed X.400 aims to create a standard linking protocol that will allow one e-mail system to talk to another without today's hassle. But, standard addressing schemes remain problematic.

In New York, a fellow named John Coonrod (readers who would like to contact him can try MCI through the EMS link THPINYC, which had the ID number of 392-1119. His MBX is JC.POSTMAST@THPINYC (JC)) is trying to create a demand for an international business card-naming convention for e-mail users. As you can see by his convoluted e-mail address, this is sorely needed. His idea is also to create an e-mail league and adopt a list of demands, to wit:

- You should only have to use one mail system, and it should be the system most useful to your daily work.

- Mail should come to you; you shouldn't have to go after it. Your screen should notify you when you have mail waiting.

- You should be able to attend to mail without interrupting your other work.

- You should be able to reach anyone on any other mail system within some reasonable interval, like an hour.

- You should have a way of organizing your messages and tracking receipts and replies.

- Every address should be expressible in DNS form, and all mail systems should accept DNS addresses on their To lines and handle them intelligently.

- Every mail system should be able to handle and exchange 8-bit binary attachments.

- When in doubt, you should be able to send to "postmaster" (or "info"?) on any system, and get a reply.

Unfortunately, Coonrod passes over his original desire to create a business card standard. He likes the DNS addressing scheme, which reeks of Unix-style haute nerdiness. Internet or any Unix-based national messaging system users know how silly these schemes are, with exclamation marks, peculiar code words,



and "@" signs in the address. Only a Unix hack could love such a thing.

Addressing an e-mail memo to "J. Dvorak, PC Magazine" should suffice. I'd even go for a long e-mail "phone number" assigned by a clearing house. The number would be your box number, like a CompuServe ID.

E-mail is the messaging system of the future. It's time we started to standardize it and put fax back into the museum where it belongs.

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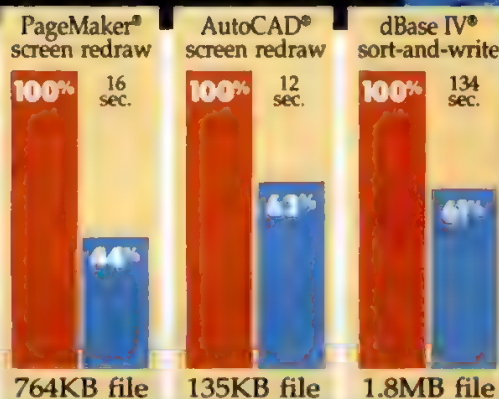
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The Never-Ending Battle

Dept.: With the rumored development of a new version of MS-DOS, developers seem

more and more concerned about what to write code for: DOS, *Microsoft Windows*, or OS/2. At the *PC Magazine* Editors' Days, an event where the editors go to various cities and meet with developers to discuss new and future products, there is also a question and answer session with the columnists. **Rarely** is the question about DOS versus *Microsoft Windows* versus OS/2 not asked. The software developers who attend these events hope upon hope that we can help them **predict** the direction of the industry so they can get a jump on the competition.

Unfortunately, we're **not much help**, since nobody on staff can agree on the best thing to do. Bill Machrone likes *Windows*, to a point. Jim Seymour likes *Windows*, kind of. But he also likes OS/2. Will Zachmann loves OS/2, but thinks *Windows* will be an interim success. I like everything, but tell developers to **write for DOS—you can't go wrong**. The fact of the matter is that *Windows* is still a DOS shell. And while a DOS program may not be optimized for *Windows*, you can still run DOS programs if you run *Windows*. It doesn't work the other way around. OS/2 will also run DOS programs. Heck, there are emulators running on the Mac that will run DOS programs.

Lite Mania Dept.: I didn't think this "Lite" marketing phenomenon (that reached its peak with beer brands) could possibly carry over into the world of the PC, but it did. We're hopeful that the next trend won't mimic **beer fads** and thus give us "Dry" software as it did Lite software.

One recent Lite entrant is *PC-Write Lite*. What could that be? The original *PC-Write*? Perhaps WordStar International should **reintroduce WordStar 2.0** and call it *WordStar Lite*. Some years back, during a fad similar to this one, WordStar International, then known as Micropro, rolled out a word processor written in Modula II that they called *Easy*. It was designed, I was told at the time, for people who **didn't like computers**.

This meant to me that there was no market. People who don't like computers usually don't own computers anyway—a fact that's lost on these marketeers.

So industry gossips tell me that **Microsoft** is working on an **OS/2 Lite**. I have no idea what this could possibly be. Perhaps it's **really DOS!** More recently, there is a proposal on the desks at AT&T to market a **UNIX Lite**. This supposedly will be a generic shrink-wrapped version of the operating system designed to run on high-end PCs and aimed at

Inside Track

heading off the potential success of OS/2. If AT&T **has the guts** to sell the thing for \$25, then I'm sure it will be a suc-

cess. Of course we all know that the company will sell it for \$200 or \$300 or \$400 or \$500 or who knows what. These guys are **so overconfident** that the sky is the limit when it comes to pricing. And don't forget that people who come from the minicomputer market can never price things right in the desktop world. **Expect the worse.**

Lotus-Novell Dept.: While AT&T tries to compete with

Microsoft with UNIX Lite, Lotus has decided that it will try the **BLOC Development** method of mergers and acquisitions to grow. In the early days of the PC, Lotus was doing better than Microsoft, but that didn't last. Without a lot of outside help, Bill Gates has managed to keep expanding Microsoft like nothing we've ever seen. Any Microsoft buyouts of any company are **not to bloat the numbers**, but to simply buy technology that can be incorporated into the Microsoft line.

Microsoft seems **unstoppable** as it manages to juggle its operating system efforts, applications business, language technology, and even book publishing business.

Lotus seems as though it can only sell

Lotus 1-2-3. Super products like *Magellan* and *Express* get short shift, and Lotus **can't even make a dent** in the Macintosh world. Unable to compete with Microsoft for the workingman's computer dollar, Lotus is hoping that the trend toward **smaller, faster, and cheaper** will magically vanish and somehow **Godzilla-like big iron** will return or massive networks will emerge as king of the hill. So it figures it has a winner in the **ultimate combo** of elaborate systems: Novell and *Notes*. *Notes* is the complex groupware product that isn't even sold to individuals, but only to large corporations for tens of thousands of dollars.

There's nothing wrong with pursuing the **fat cat** market of minis and mainframes and other big budget buyers. But it seems once a company concentrates on that business it becomes stodgy like, say, Cullinet. They can't imagine selling 50 million copies of something, for example. While looking at big, expensive installations, they actually end up **thinking small**. There are no Proctor and Gamble marketing guys (such as Microsoft's Steve Ballmer) at these firms who understand big-time mass merchandising.

Not True Dept.: Contrary to rumors, IBM will not change its slogan from **PS/2-It!** to **PS/On-It!** Who sits around and dreams these things up anyway?

End of **Diatribes** number 733. ■

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CIRCLE 284 ON READER SERVICE CARD

Jim Seymour



When Small And Simple Is Just Right

An important part of being a power user is matching the tool to the task. Sometimes simpler is better.

Last issue I talked about an unfortunate phenomenon I see occurring in the PC software business: new programs that are so powerful and feature-laden that they overwhelm the needs of most users.

Big, complex programs can be applied to small tasks, but it's silly and frustrating when people use only a tiny fraction of their features. Why buy a \$500 package, then use \$25 worth of its features? And why invest so many valuable hours learning to use such a brawny program—figuring out how to select that subset

of features you need for your single task—when, in minutes, you could learn to use a smaller, simpler program better-suited to the job?

Even true PC power users, it seems, do some work at the computer that requires quick, simple, often single-purpose tools. But it's getting aw-

fully hard to find those programs.

Readers sometimes bang on us at *PC Magazine* for pushing too hard on the performance envelope. Bill Machrone and I have gotten a lot of unhappy letters, for example, because of our insistence that it's a mistake to keep buying 286 PCs when the 1990s clearly belong to 386s and their heirs.

But as stoutly as Bill and I hold to our views on 386s—because investing in a computer puts that box on your desk for years to come—we know the newest, biggest and fastest tools aren't always the *right* tools, especially when it comes to software.

Software publishers are wary of small programs. The economics of PC software publishing are built upon two ideas: ever-more-powerful upgrades keep those checks rolling in from current users of a program. And new programs more powerful than anything anyone has ever seen seem to have the best chance to edge onto the best-seller lists.

Those vendors, too, often bang on us at *PC Magazine*, saying they're afraid to bring out

new programs that don't have every feature imaginable, lest a reviewer point out that their new wonder doesn't do something another program can—no matter whether anyone uses that feature.

BIG OPPORTUNITIES, SMALL PROGRAMS

Still, I'm convinced that one of the biggest opportunities in the PC business today lies in small, easy-to-use, relatively inexpensive programs. But very *good* ones. Because once a PC user has become accustomed to the elegance of *Paradox* or *Microsoft Excel*, he or she is not going to put up with buggy code, bad interfaces, or incomprehensible documentation in even the smallest and least inexpensive programs.

It should be the size of the task, not the size of the programmer's ambitions or the publisher's ego that determines the scope and features of these smaller programs.

There are several good examples of publishers making money catering to this huge market. One of my favorites is the group behind the Power Up! catalog you probably get in the mail. Once part of Software Publishing, Power Up! was bought a few years ago by Ed Lauing, who

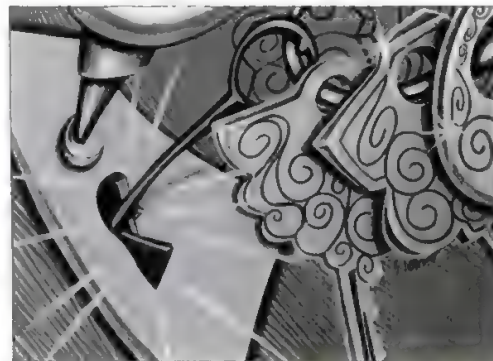


ILLUSTRATION: SHANNON JEFFRIES

has built it into a sizable operation.

Many PC users—and especially corporate power users and micro managers—tend to sneer at such alternative-channel sources. Certainly it's true that a lot of the software in Lauing's catalog is strictly home PC stuff, from banner-printing programs to recipe filers. But scattered among the home-inventory, genealogy, and Christmas-card-list programs are some gems of great value to businesspeople.

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CIRCLE 524 ON READER SERVICE CARD



Jim Seymour

I'm a big fan of to-do lists, for example. I find that a few minutes spent in the morning with a daily to-do list makes me far more productive, far more focused all day long. But though I've looked for a way to build a really good to-do list with literally dozens of well-known PC programs—including such high-end personal information managers as *Agenda*—I'd never found what I wanted until I tried the Power Up! package, *Top Priority*.

It lets me keep a rolling to-do list, categorized into several areas, each of which can be added to or subtracted from the "view" of my day.

Top Priority offers a variety of to-do printouts. The one I like groups tasks into appointments, today's tasks rank-ordered by priorities, a list of what I've gotten done so far today, a peek ahead at upcoming deadlines, and a space to write in things that come up when I'm away from the computer. Completed tasks are automatically swept into a "finished" list, which is then deleted from tomorrow's report. Things I *don't* get done are carried over, along with a note of the number of days they're overdue.

Keeping a to-do list *ought* to be a quick and easy job; and it's one we ought to be able to do on a PC. For \$79.95, *Top Priority* lets me use the power and convenience of a PC for the job, while avoiding the complexity of a PIM.

Other Power Up! gems include programs for scheduling employees, business-plan templates, and more. Interfaces are clean and spare, and the programs don't require graphics cards.

In the beginning, many Power Up! programs were bought from outside. Now, Lauing's staff develops hits such as *Top Priority* as Power Up! exclusives. The catalog also offers simple, economical programs seen elsewhere, such as *Timeslips*, *Quicken*, *TurboTax*, and *Impress*.

Lauing is on to something.

Even power users need programs like these, though too often we overlook them because of their nontraditional channels of distribution.

But an important part of being a real power user is matching the tool to the task. You can use *Agenda*, *Lotus 1-2-3*, or *Oracle* to do a lot of things. But like the man said, when you've got a hammer, everything starts to look like a nail. ■

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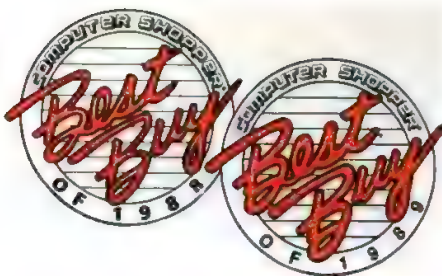
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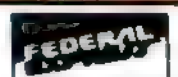
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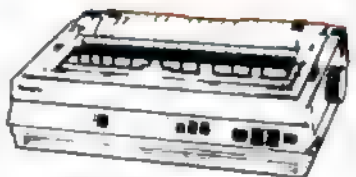
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No Escape From the Keyboard

Handwriting interface technology has promise, but it isn't going to replace the keyboard any time soon.

People who can't touch-type have always looked for ways to avoid using a PC keyboard. For these folks, voice recognition, mice, optical character recognition, and the like are perennial topics of interest. Now you can add to that list gizmos that provide handwriting interfaces of one sort or another to PCs.

A major mover in this arena is GRiD Systems Corp., the manufacturer of the GRiDPAD, a handheld notebook-size PC that uses pen-interface technology and recognizes printed handwriting. GRiD recently sponsored a conference on the pen

interface and handwriting recognition that attracted a host of industry gurus, who sang the praises of pen input.

If you believed these enthusiasts, you might have concluded that keyboards will soon go the way of the

dinosaur and the dodo. Millions of computer users, they claim, will soon be putting pen to screen (or perhaps to tablet) instead of struggling with their QWERTY keyboards.

But before we fling our keyboards into the trash, we should consider whether these other input technologies will provide a practical alternative to keyboards. Are we really going to replace keyboards with one of these in the foreseeable future?

A BRIEF HISTORY

Perhaps the oldest of the keyboard alternatives, at least in terms of commercially available products, is optical character recognition (OCR). This technology goes back to the days when the keyboard in question wasn't on a personal computer or even a computer terminal, but on an old-fashioned keypunch machine that punched holes in IBM cards.

OCR devices first appeared on the market in the late 1960s. They cost hundreds of thousands of dollars, and they were restricted to reading specialized OCR fonts. Not surprisingly, they were heralded as a breakthrough technology that would revolutionize comput-

ing and replace the keyboard.

They didn't, of course. Sure, a fair number were sold and put to use in one way or another. But in the scheme of things their impact was minor, to put it charitably.

More than two decades later, after costs for the scanning and image digitization hardware that OCR requires have fallen and the OCR algorithms for turning a scanned and digitized image into its character representation have improved, OCR is still barely more than a footnote to general business computing.

The reasons for this aren't complex. First, OCR is of real use only in converting printed text to machine-readable text, which is necessary in a surprisingly small number of situations. Most folks in the business world do not normally write letters and memos by reusing text they've received from somebody else.

What's more, as a growing proportion of business communication moves toward machine-readable interchange formats—from sophisticated electronic mail to the simple exchange of floppy disks—the need to turn letters on paper into characters in storage is likely to shrink rather than to grow.

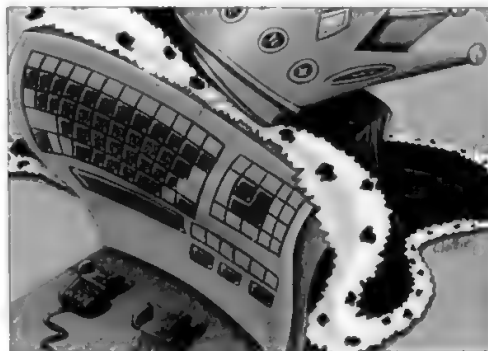


ILLUSTRATION: SHANNON JEFFRIES

Voice-recognition technology also dates back to the 1960s. Like OCR, it has improved enormously over the past two decades and has dropped dramatically in price. And like OCR, voice recognition remains more an interesting curiosity than a mainstream technology.

Unlike OCR, which isn't likely to be more than a niche technology, voice recognition could amount to something significant someday if true continuous speech recognition becomes possible at a sufficiently low cost. No amount

William F. Zachmann

of technological advancement in OCR will eliminate the fact that machine-readable communications will largely replace paper media anyway.

The problem with voice recognition, however, is that true continuous speech recognition remains a distant dream. Even

the most expensive voice-recognition systems aren't capable of accurately translating ordinary speech into text.

The more affordable systems for PCs, although still much more expensive than a regular keyboard, are even more limited. At best, they can be trained to recognize a modicum of discreet words spoken by a specific individual and can work with an even smaller speaker-independent vocabulary.

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CIRCLE 190 ON READER SERVICE CARD

BETTER-KNOWN ALTERNATIVES

Mice and other alternate input devices are only slightly newer than OCR and voice recognition. While they have been much more successful than those two technologies, mice and similar devices have only gone so far as to supplement keyboards, not replace them.

Case in point: The Apple Macintosh, which more than any other system was designed for maximum reliance on the mouse, has come to depend on the keyboard. The limited keyboards of the early Macs have been replaced by IBM-like expanded keyboards, since a substantial number of people still prefer to use a

Keyboards will remain the primary means of access to PCs for the foreseeable future, even if they are supplemented by pointing devices.

keyboard even for tasks like selecting menu items or blocks of text.

The fates of these better-known alternatives provide a useful background against which to evaluate the recent minifad for handwriting recognition.

In fact, today's pen interface products are no more able to read ordinary handwriting than the most advanced, multi-million dollar voice-recognition systems are capable of recognizing continuous speech. Even the most unskilled typists will find that in most cases these devices do not offer them a substantial advantage over keyboards. Kludgy as a keyboard may be for the untutored, most users will find writing to a PC by hand is even worse.

For the majority, keyboards will remain the primary means of access to PCs for the foreseeable future, even if they are supplemented by mice or other pointing devices and, for special purposes, by other technologies as well.

Still, for any child coming of age during the 1990s or beyond, my advice would still be to take the trouble to learn touch-typing. It isn't a skill that will become obsolete any time soon. ■

The Graphical Interface for Lotus 1-2-3! Professional "Spreadsheet Publishing."

1-2-3 Stays FULLY Functional and Interactive!

How good are your spreadsheets at "explaining" themselves? Without you there to illuminate important numbers, trends and conclusions, do they have the same impact?

With Impress, your Lotus 1-2-3 spreadsheets take on a dynamic new look. In fact, Impress works as a graphical interface for 1-2-3 — and allows all editing commands to remain active. This remarkable new version provides a set of desktop publishing tools that add style and clarity to your numbers. Highlight details with drawings, arrows and boxes that take the reader where you want him to go. Mix numbers, text, graphics, custom charts and graphs to create a new level of spreadsheet power.

And since 1-2-3 stays completely functional within Impress, you won't have to revert back to text mode to edit cells. Revisions are made dynamically using Lotus commands from within Impress. Even your charts and graphs change as you replace numbers. You'll work quickly and effortlessly, exploring more options than ever before, crafting each spreadsheet into a useful financial tool.

Mouse Support and Drawing Tool Box

Impress brings a true graphic interface to Lotus 1-2-3, including an optional mouse support to call menus and open windows. Even has a drawing tool box that allows you to draw any image or logo in 1-2-3. Get a professional look quickly and easily without ever leaving 1-2-3.

Mix Numbers, Text and Graphics

Create a professional report with numbers, graphs, images and text all on one page. Your graphs are customized. Your text automatically word wraps and is justified. You have a choice of different type styles and sizes with different fonts (3 pts. to 72 pts.). Many high quality Bitstream Fonts included. Your images are created with the drawing tool box or imported from Freelance. You can do all this from within Lotus 1-2-3.

Flexible Page Layout

Use your mouse or keyboard to place worksheet elements (text, graphics, illustrations, data) exactly where you want them on your page. Overlap, reposition and resize graphs or images with a sweep of your pointer, even rotate text!

Compress or Enlarge Worksheets

You can customize your 1-2-3 screen display with drawings, colors, grids and new exciting fonts. You can also zoom in and out to compress worksheets or enlarge them. See twice as many rows and columns of your worksheets on screen while you work in Lotus 1-2-3.

1-2-3 Stays Fully Functional at all Times.

While in Impress, Lotus 1-2-3 commands stay fully active. Unlike Allways, you never have to revert back to text mode for editing cells or using 1-2-3 commands.

"Impress is the clear winner."

—PC Magazine

Also Prints Sideways

Print your extra wide worksheets sideways with all printers from dot matrix to laser and desk jets. Print exciting reports with color printers. Impress can also compress worksheets automatically so they fit any page size you want.

Customize Graphs or Forms

Graphs can be real time synchronized with your worksheet. The graph is updated automatically as you change your worksheet. You can also include .PIC files or Freelance files. Customize your 1-2-3 graphs with arrows, explanations, titles and drawings.

Word Processing Capabilities

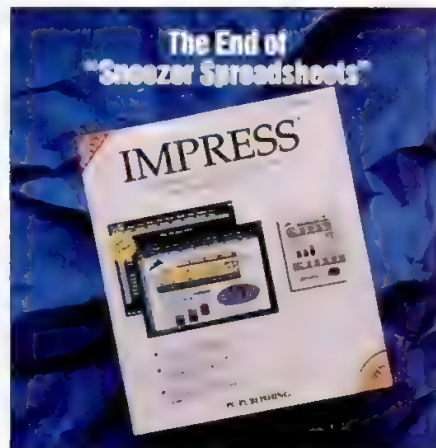
You have automatic word wrap and centering of titles. Automatically align and justify (right or left) your text. Change attributes or fonts for each character in a cell.

Easy to Use

If you know how to use 1-2-3, you already know how to use Impress; it's fast and easy. There is no learning period. Impress uses 1-2-3 like menus that you are already familiar with so you can be up and running in minutes.

Allways and 1-2-3 Rel 2.0, 2.1, & 2.2 Compatibility

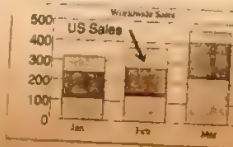
If you have Allways, Impress imports Allways files automatically. You can manipulate them any way you like, or simply work on them without having to toggle to text mode. Impress is a Lotus 1-2-3 add in and works with 1-2-3 Rel. 2.0, 2.01, & 2.2. With Impress Lotus 1-2-3 stays fully functional at all times.



Budget Results 1st Q. 1990

	January	February	March	Total
INCOME				
National Sales	114,987	134,572	231,782	481,321
Int'l Sales	125,813	134,226	176,543	436,582
Other Income	78,300	103,456	55,462	237,218
Total Income	319,100	372,254	463,787	1,155,121

Our Worldwide sales are reaching new heights Double Bonus for everyone this year

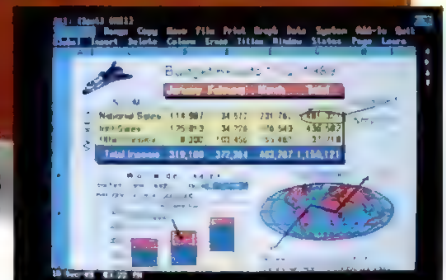


We have reached our goals for this year and we expect to double our sales next year. Profits are up by 200%. Our market share is up by 50%. We suggest an increase in dividends and \$1,000,000 bonus to employees

National Sales	114,987	585,643	231,782	912,392	1,709,797
Int'l Sales	125,813	134,226	176,543	436,582	747,351
Other Income	20,475	103,456	55,462	179,393	338,311
Total Income	261,275	823,325	463,787	1,548,387	2,795,459

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**IMPRESS PRODUCES
BETTER RESULTS,
FASTER & EASIER!**



Impress vs. The Competition

	The IMPRESS Competition	
1-2-3 stays fully functional & interactive	Yes	No
Enhance & customize 1-2-3 screen display	Yes	No
Print sideways on laser printers	Yes	No
Synchronized live graphs	Yes	No
See & work with more rows & columns on screen	Yes	No
Drawing tool box	Yes	No
Import Freelance images or graphs	Yes	No
Word processing capabilities	Yes	No
Customize graphs with arrows, frames, drawings	Yes	No
Full mouse support	Yes	No

Impress

Just \$149.95

LW 2450 Impress 5 1/4" \$149.95

LW 2455 Impress 3 1/4" \$149.95

IBM PC, XT, AT, PS/2 or compatibles. 1-2-3 release 2.0, 2.01 or 2.2, DOS 2.0 or later. Requires 65K RAM. Supports all graphics printers that work with 1-2-3.

► Backup Your Hard Disk. ► Print Spreadsheets Sideways. ► Integrate Your Office!

Three Programs to Increase Your Computing Power.

You can write a business letter, spell-check it, merge it with your customer list, even add your 12-month financial forecast. Or, print out your extended analysis — sideways — no cutting and pasting. Then, backup everything for safe keeping!

► **Office Manager.** The Toolworks Office Manager is four business programs in one: a word processor,

spreadsheet, database filer and spell checker — all completely integrated. And all you have to know is how to press the Escape, Enter and Arrow keys.

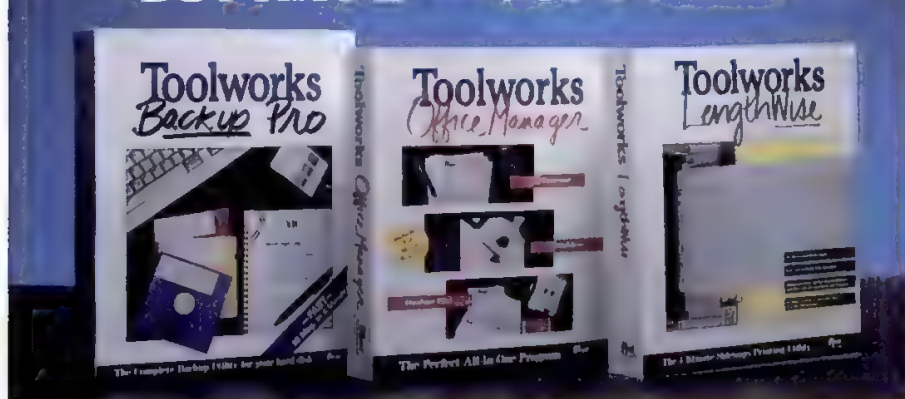
- **Word Processor.** Documents can be as large as memory; supports user-installable typefaces.
- **Spell Checker.** Over 100,000 words included.
- **Spreadsheet.** 2,048 rows by 255 columns; reference external spreadsheets.

• **Database Filer.** 8,000 fields per record; 16,000 records per file.

► **Backup Pro.** The complete backup utility for your hard disk. Back up 10 megabytes in as little as 4 minutes! Backup Pro's all-new proprietary disk access algorithm beats DOS — and the competition — hands down. There's a full directory-tree display for simple "point and shoot" backup selection. Back up the files individually or as a group. With 4 full levels of data security, Backup Pro is the safest backup utility available. ECC (error correction coding) can read the backup disk even if the disk has been damaged after backup. *Read After Write* double checks the data written. *Compare* checks the data and length or all data on a byte-by-byte basis for identity with the original. And, the *Rebuild* option restores your data even if you're missing disks.

► **LengthWise.** Never cut-and-paste again! Introducing LengthWise, the new standard in sideways printing. LengthWise prints your spreadsheet or other data (no matter how wide or how many columns) quickly and easily, on one continuous piece of paper! In any length you need. As many copies as you need. Plus, LengthWise has more rows, more fonts, more columns, more options than any other sideways printing program on the market. Works with any program and from within Lotus 1-2-3, Symphony, VP-Planner Plus, Framework II/III and Quattro! LengthWise supports all known dot-matrix and most ink-jet and laser printers.

BUY ANY 2 — GET 1 FREE!



Toolworks Just \$49.95

LW 1006 Office Manager 5 1/4" & 3 1/4" \$49.95

LW 1007 Backup Pro 5 1/4" & 3 1/4" \$49.95

LW 1008 LengthWise 5 1/4" & 3 1/4" \$49.95

BUY 2 GET 1 FREE!

IBM PC, XT, AT, PS/2 and compatibles.

INSTANT SCREEN COMPRESSION.

See More Columns and Rows On Your Screen in Lotus 1-2-3!



See a 12-Month Forecast with No Scrolling.

SeeMORE is standard equipment for hundreds of thousands of Lotus and Symphony fanatics around the world. The concept of screen compression for expanded views of rows and columns makes obvious good sense.

Now, SeeMORE Version 2 includes a host of new innovations that make working with Lotus even more professional and productive. Don't work in "tunnel-vision," see the forest — and the trees.

Instant Screen Compression.

Like its predecessor, SeeMORE™ Version 2 lets you see more rows and columns on screen. You get a choice of compressed fonts that double, triple or quadruple the number of cells displayed. Zoom in or out with the push of a key.

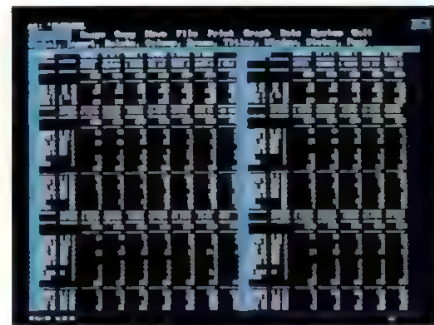
SeeMORE lets you build a 12-month forecast without constantly scrolling left and right. All 12 months appear on the screen. Immediately, you become more productive. Then, something else happens — you become more perceptive. Trends and relationships become clear. SeeMORE lets you see the big picture.

Windows and Graphs.

New in SeeMORE Version 2 is a powerful window manager that lets you create an unlimited number of tiled or overlapping windows in any worksheet, including multiple graph windows. All windows remain active as you enter and edit data. Build a macro in one window while monitoring its operation in another. Change cell values and watch graphs update automatically. You can easily change the size and position of any window and set "restrict ranges" to limit cursor movement.

No Special Hardware Required.

SeeMORE works with 1-2-3 release 2, 2.01 and 2.2 or Symphony 1.1, 1.2, 2.0 and 2.2 on any PC equipped with a standard graphics adapter including CGA, EGA, VGA, MCGA, Hercules, 3270PC, AT&T 6300 and most laptop displays. See for yourself why Lotus magazine says, "SeeMORE is brimming with innovations."



SeeMORE allows several sizing options, from big to tiny. You can see the big picture — with SeeMORE.

BUY SEEMORE GET INSTANT ANALYST FREE!

Instant Analyst is a great new product from the makers of SeeMORE. It lets you see hidden trends and relationships in spreadsheet data. A \$69.95 value — FREE with SeeMORE!

SeeMORE Screen Sizes

	Big	Med.	Small	Very Small	Tiny	Presentation
CGA	80x25	91x28	106x33	128x25	128x33	40x25
MCGA	80x30	91x37	106x48	128x53	160x60	40x30
EGA	80x25	106x38	128x43	160x43	160x58	40x25
Hires EGA	94x29	107x31	125x41	150x51	150x68	47x29
VGA	80x34	91x37	106x48	128x53	160x60	40x34
IBM 8514/A	80x34	91x37	106x48	128x53	160x60	40x34
Hercules	80x25	90x43	120x43	144x43	180x58	45x25

personics

SeeMORE Just \$89.95

LW 1003 SeeMORE 5 1/4" & 3 1/4" \$89.95

LW 2815 SeeMORE for Symphony \$89.95

IBM PC, XT, AT, PS/2 or compatibles. Requires graphics.

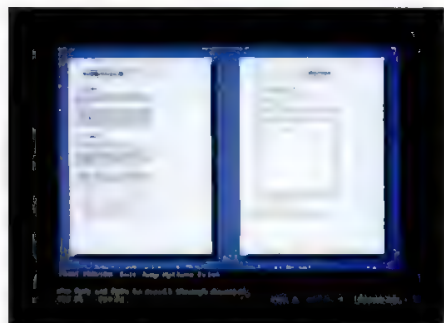


So Competent, So Feature-Rich, They Just Call It "Word."

Truly the Elite Word Processing Software.

For years, Microsoft has been setting the standards in software design and functionality. Nowhere else is this commitment to excellence more classically embodied than in Microsoft Word 5.0. This fine package quickly brings users to sophisticated new levels of word processing, offering advanced functions and innovative techniques with fewer keystrokes.

In fact, Microsoft Word 5.0 has shortened the distance between your ideas and your documents. And along with superior speed and ease, Microsoft Word 5.0 delivers complete creative and technical control over the entire production of your document. That's important, because features don't mean very much if you can't use them.



Microsoft's amazing new Print Preview offers users a look at their documents exactly as they will appear when printed. The user interface makes any operation fast and simple. Competent, feature-rich, easy-to-use — Microsoft Word 5.0 is the elite word processing software.

Word's Shortcuts Make Your Life Simpler.

Microsoft Word 5.0 provides shortcuts for virtually every function, with its streamlined interface that simplifies tabs, columns, style sheets; and provides award-winning on-line training. Mix text, graphics and data in just a couple of keystrokes. Simple steps allow you to quickly import graphic images and spreadsheet data from other programs, and Microsoft Word automatically builds "links" to your other applications, so updating the information you import now takes just seconds.

That's Just the Beginning...

Microsoft Word 5.0 does so much, so effortlessly, it's hard to know where to begin. Some users are crazy over the new Print Preview feature that allows you to see two pages — right on your screen — exactly as they'll appear when printed on paper. Then there's the new ability to edit columns side-by-side, right on your screen, and the flexible tab system that breezes through complex tables for memorable documents. Some users love the ability to create Outline views to organize their documents, and the "record-keystroke" functions along with the fully programmable macros.

Microsoft Word 5.0 also contains an advanced new document management system that handles retrieval, sorting and archiving across multiple directories, and a new system that automatically paginates your longer documents.

Anything New for the Power-Monger?

Microsoft Word's power features are so quick and easy, everyone will harness their productivity. Redlining and annotations, network support and more just keystrokes away, and to get started, Microsoft's on-line training puts it all together.

Microsoft Word Formats

- ▶ **Memo.** Microsoft Word can produce a formatted memo heading with just a few keystrokes. You can easily customize memo headings to suit your own needs, and store to use repeatedly.
- ▶ **Résumé.** Your résumé is your ambassador. Because it represents you when you are not present, the impression it gives is important. Use Word's powerful formatting capabilities to draft and fine-tune your résumé; then preview its appearance on screen before printing.
- ▶ **Outline.** Even if you write first and then outline a document, you can use Word's outlining feature. Use a style sheet to format as you write; then you can shift between a view of the whole document and a view of the outline.
- ▶ **Table of Numbers.** Write text for a financial report, import data into Word from a spreadsheet program, and then combine the text and the financial data into one document. Format the imported data and fine-tune the table's appearance.
- ▶ **Brochure.** Use Word and a laser printer to produce attractive brochures and other printed pieces. Write text, design the brochure, and position text and graphics on panels. See your design on screen as you refine it.
- ▶ **Letter and Envelope.** Format a two-page letter with the first page on letterhead and the second on plain paper. You can date the letter automatically and insert text you use repeatedly in correspondence. When the letter is finished, format the envelope and print both.
- ▶ **Brief.** Word can mark the authorities in a brief and then build the table of authorities. Use Word style sheets to ensure that the brief is formatted correctly for each court in which it will be used.
- ▶ **Contract.** Build even lengthy contracts with a few keystrokes by inserting stored blocks of boilerplate text and then filling in the particulars. You can use Word to redline the changes in a contract before making them final.
- ▶ **Script.** Scripts written for different media have different page-layout styles. With Word, you can use style sheets to automatically format scripts as you type them.
- ▶ **Academic Papers and Long Documents.** Format a long paper easily with Word's style sheets. Use styles to format titles, quotes, footnotes, and the bibliography, and to number pages in the various sections of the paper.

FREE!

RightWriter and Word For Word!

▶ **RightWriter** (a \$99 value) checks grammar, style, usage and punctuation in your letters, reports and proposals. It helps you produce clear, powerful writing with just a simple one-word command.

▶ **Word For Word** (a \$149 value) allows you to translate files between word processing formats. Don't lose files when you switch word processors!



New Microsoft Word 5.0 Helps Your Words, Ideas, Plans and Dreams Leap to Life!

Easier Than Ever To Use!

Microsoft Word 5.0 has been crafted to offer maximum functionality with minimum effort. It contains award-winning training and help, plus a set of reference guides that illustrate the magic of this word processing masterpiece.

Make Yourself a "Word" User...

Hundreds of thousands of people depend on Microsoft Word to handle their word processing needs. Built to perform, designed to grow with you, Microsoft Word 5.0 leads the way in word processing in the PC environment.

It has become the industry standard for corporations, government and educational institutions.

That's why we say that Microsoft Word 5.0 is the shortest distance between your ideas — and your documents.

Microsoft

Microsoft Word Just \$359.95
with FREE RightWriter & Word For Word

LW 1450 Microsoft Word 5¼" \$359.95
LW 1455 Microsoft Word 3½" \$359.95

IBM PC, XT, AT, PS/2 and compatibles. 192K RAM, DOS 2.0 or higher, 80 column printer.

Turn Your LaserJet into a Powerful PostScript® Printer!

Big, Bold Headlines, Unlimited Fonts Without a Cartridge, Breathtaking Graphics and More!

The graphics revolution has been swiftly ushered in by the advent of PostScript. But PostScript printers come with a handsome pricetag. Now you can turn your HP LaserJet (including LaserJet II, IIP, DeskJet, DeskJet Plus or any HP compatible) into a fully functional PostScript powerhouse for hundreds less. And PreScript™ is designed only for HP and compatible printers, so installation and functionality are simple. PreScript gives you access to unlimited type fonts and sizes (from microscopic to monstrous), allows twisting, rotating, scaling, curving, clipping, outlining and shading type for a wide range of dramatic graphic effects.

Printer Compatibility.

HP-IIP, HP-LaserJet Series II, and all 100 percent HP-LaserJet compatibles. (All require 1MB of printer memory for full page graphics, except the LaserJet Series II with the optional POC Laser Interface Cards which requires 512K). HP-DeskJet Plus (no additional printer memory required).

What Is PreScript?

The POC PreScript printing system consists of a collection of special software driver programs and, optionally, a set of plug-in circuit boards designed for HP Series II LaserJet Printer. The PreScript system can operate as either a software only PostScript interpreter, supporting HP LaserJet or HP-PCL compatible printers, or, with a set of plug-in circuit boards designed to operate with the HP Series II Printer for much better performance. If PreScript is installed as a software only PostScript printer interpreter, then the user will need an additional 512K of printer memory in their Hewlett-Packard laser printers for full graphics output. Both configurations will deliver the exact same printed results.

Some Technical Highlights of PreScript.

PreScript operates as a DOS "Terminate-Stay-Resident" (TSR) program in 80286/80386 "protected-mode." By using the sophisticated resources of protected-mode, PreScript can intercept normal output to a printer port, and while operating completely in the background, process PostScript commands and generate HP-PCL output to drive your LaserJet/DeskJet. PreScript processing is completely "invisible" to the application program that generates the PostScript output.

Two Versions to Choose From — Standard and Deluxe.

Standard Version — 13 Popular Type Styles!

- Courier
- Courier-Bold
- Courier-Bold Oblique
- Courier-Oblique
- Helvetica
- Helvetica-Bold
- Helvetica-Bold Oblique
- Helvetica-Oblique
- Times-Bold
- Times-Bold Italic
- Times-Italic
- Times-Roman
- Zapf Dingbats

Deluxe Version — 35 Popular Type Styles!

Apple LaserWriter Plus II NT/NTX compatible, Adobe width compatible.

- Avant Garde Book
- Avant Garde-Book Oblique
- Avant Garde-Demi
- Avant Garde-Demi Oblique

NEW PRODUCT



- Bookman-Demi
 - Bookman-Demi Italic
 - Bookman-Light
 - Bookman-Light Italic
 - Courier
 - Courier Bold
 - Courier-Bold Oblique
 - Courier-Oblique
 - Helvetica
 - Helvetica-Bold
 - Helvetica-Bold Oblique
 - Helvetica-Condensed
 - Helvetica-Condensed Bold
 - Helvetica-Condensed Oblique
 - Helvetica-Condensed Bold Oblique
 - Helvetica-Oblique
 - New Century Schoolbook-Bold
 - New Century Schoolbook-Italic
 - New Century Schoolbook-Italic
 - New Century Schoolbook-Roman
 - Palatino-Bold
 - Palatino-Bold Italic
 - Palatino-Italic
 - Palatino-Roman
 - Times-Bold
 - Times-Bold Italic
 - Times-Italic
 - Times-Roman
 - Symbols-Greek
 - Zapf Dingbats
 - Zapf Chancery-Medium Italic
- PostScript is a trademark of Adobe Systems, Inc.

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PAN OVERSAS
COMPUTER
PreScript

From \$175.00

- LW 1040 PreScript Standard 5 1/4" \$175.00
- LW 1045 PreScript Standard 3 1/4" \$175.00
- LW 1100 PreScript Deluxe 5 1/4" \$299.95
- LW 1105 PreScript Deluxe 3 1/4" \$299.95

DOS 3.1 or higher, 80286 or 80386 PC/AT compatible. Parallel printer port. 640K to run as standalone; 2 Mbytes Extended to print within applications. Hercules, EGA, VGA or Super VGA. 1 MB of printer memory or optional POC.

"But My HP Won't Print Graphics!"

...It will now! With PreScript, you're no longer at the mercy of your HP's limitations. Illustrations, graphic images, charts, graphs can be added to your newsletters, reports, proposals and other desktop publications — then printed on your HP! PreScript's advanced scaling capabilities make it fast and easy to add graphics that fit precisely into your layout. And with PreScript you don't have to exit your application to print. In fact, PreScript runs transparent to DOS and Windows for fast, smooth on-line operation.

Prints FIVE Times Faster Than Your HP!

Speed is important when printing graphics-enhanced documents. And mixing typefaces used to mean changing font cartridges and downloading fonts. That can slow your printer down more. PreScript handles any graphic images, any combination of fonts — for any job — with speeds you never thought possible! After all, what good is increased printing power if it takes longer to print?

PreScript's WYSIWYG Eliminates Guesswork...

PreScript provides a unique WYSIWYG preview function and is ideal for programs running under everything from PageMaker to Windows. You can even view EPS files right on your screen. PreScript helps you save time and toner.

Perfect for All PostScript Applications...

PreScript will produce dazzling results using PageMaker, GEM Graphics, Excel, Adobe Illustrator, Ventura Publisher, Microsoft Windows, PC Paintbrush, Lotus 1-2-3, Corel Draw, Ami, Micrographix Designer and more.



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Power Managers: How to Organize the '90s.

All New!
VERSION 2.0

"Most impressive... offers clear advantages over conventional business diaries."

—Business Week

Helps You Plan, Prioritize, Schedule, Delegate, Track And Analyze Your Work — Quickly!

Who-What-When: Fully-Integrated System for People, Project, and Time Management.

Who is doing what and when is it due? Is everyone meeting their deadlines? Are you? If you can write in a daily planner, you already know how to use this simple, powerful software system.

Best-selling system used by Fortune 1000 executives and entrepreneurs to gain the upper hand. From the big picture to specific task details, Who-What-When keeps you on time, on track and in control of your work. Integrates daily calendars, weekly overview, card file, phone & address book, alarm clock, auto-dialer, and more!

Who-What-When Features:

- ▶ **Appointment Calendar & Prioritized To-Do List.** Automatic conflict checking. To-Do items carry forward until marked complete.
- ▶ **Interactive Office Scheduler.** Ideal for office managers and group secretaries. With Meeting Maker to schedule rooms, equipment, resources, etc.
- ▶ **Non-Technical Project Management.** Has project daily calendars, Timechart (Gantt) overviews, unlimited milestones and deadlines, and complete project histories. Unlimited number of projects!
- ▶ **Supports Popular Planner/Organizers** with compressed-print reports, calendars and schedules. Comes with computer paper to get started right away!
- ▶ **Hot Keys** access other programs with push-button ease. Solves TSR vs. RAM-CRAM dilemma.

- ▶ **Intelligent Dates.** Reorganizes entries such as "+10" to move forward ten days, or "TU" for next Tuesday.

How It Works. Your daily calendar entries cross-reference automatically into 3 powerful management views. Put 3 views to work for you!

The People Management View displays the people you work with, their projects, tasks, and schedules. You see complete client or co-worker histories, plus delegations with follow-up dates.

The Project Management View displays your projects, the people involved, critical milestones and deadlines. You see complete project histories — what is due when and who is responsible! Entries create Timecharts (Gantt) with unique "zoom" to project daily calendars. You can overview projects and sub-projects; create unlimited new projects on the fly.

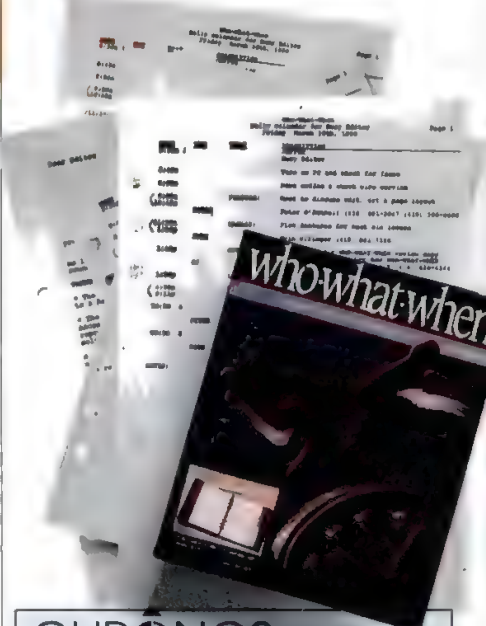
The Time Management View displays your daily calendar and prioritized To-Do list — who you're seeing and what it's about. Appointments can be entered, edited, deleted, replicated, moved, marked complete, and archived with single keystrokes!

Automated Management Reports are produced on a per person or per project basis. They save hours of writing time and crystalize the status of all work in progress.

"The perfect PIM for laptop users." —PC Laptop

"Practical, easy and useful... going from box to computer and into use in less than an hour."

—The New York Times



CHRONOS

Who-What-When Just \$295.00

LW 3540 Who-What-When 5 1/4" & 3 1/4" . \$295.00
IBM PC, XT, AT, PS/2 and compatibles. 512K RAM and hard disk required. DOS 2.1 or higher

SEE YOUR DOCUMENTS BEFORE YOU PRINT THEM...

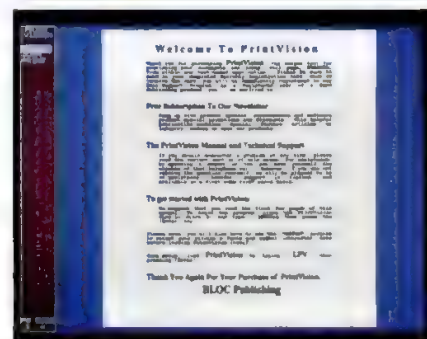
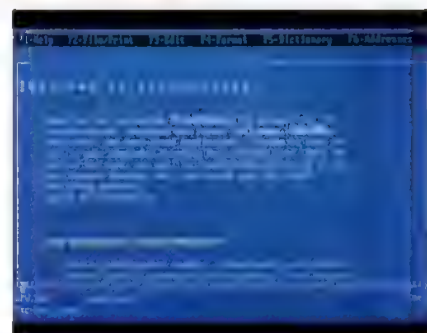
Now You Can Have a Full-Page WYSIWYG Preview, Enhance Your Creativity and Accuracy!

Save Time, Paper, Toner, Ribbons — and Money!

See your documents as they will print! With new PrintVision — a "graphics-like" preview utility that allows users to actually preview word processing documents, database files, spreadsheets, mail merge lists, charts, forms and more with a **What You See Is What You Get** — preview display.

Catch errors in layout, spacing, font changes and character sizes — before committing them to paper! Save time and money!

Non-graphics applications like word processing, databases, form and chart generators and spreadsheets have exploited the processing speed of the PC. But, text screens don't allow you to see attributes of your documents like various type styles, or bold, underline and italics. So if you have a slight alignment problem, or forget to change typestyle, you may not notice it — and print an error.



◀ Normal Word Processing File Display...

With text-based programs all you see... is plain vanilla text. When you create letters, forms, charts, spreadsheets and lists, you won't know exactly what you've got — until it's too late.

You'll save time, because you can get it letter-perfect the first time — eliminate costly "rejects." You'll also save toner, paper, and wear and tear on your equipment.

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CIRCLE 515 ON READER SERVICE CARD

◀ PrintVision Document Preview.



Now Includes Unique "Quick-Zoom" Feature.

Fast, easy zooms allow for close-up looks at any area of the document. Plus, resolution and print memory requirement indicators.

BLOC Publishing

PrintVision Just \$69.95

LW 2300 PrintVision 5 1/4" \$69.95

LW 2305 PrintVision 3 1/4" \$69.95

Runs on IBM PC, XT, AT, PS/2 and compatibles. Requires 64K memory. Will support CGA, EGA, VGA and Hercules. Supports HP compatible laser printers. Call for details.

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Now You Can Run Your Printer — While Working (at top speed) On Your PC.

PrintRite Gives You More Control with Less Work.

PrintRite allows users to run print jobs of any size — while continuing to work, at top speed, on their computer. PrintRite spools your print jobs to disk (and compresses them), allowing applications to generate print jobs at maximum speed — and save hours of printing time — and it occupies less than 50K of memory. Spend time working — not waiting for print jobs!

Designed for Easy, Efficient Operation.

Stop wasting time waiting for your printer to finish a document so you can continue to work on your PC. Harness the power of professional mainframe spooling technology — in an easy to use package.

Introducing PrintRite. Designed for fast, efficient operation, its streamlined pull-down menus allow you to print documents, lists, labels, spreadsheets — anything — *while you continue to work, uninterrupted, on your PC.*

PrintRite compresses spooled files to disk for ultra-efficient use of memory.

PrintRite spools each file separately (rather than in one large file) to eliminate costly hard-disk fragmentation. And only PrintRite allows you to control *five printers* at one time, so you can dedicate specific printers for certain tasks. Pop PrintRite up anytime and view the queue and documents on-line. Change the printing order, specify the number of copies, sideways printing, add items — even pause and restart.

Forms Alignment, Multiple Printer Support.

PrintRite will prompt you for alignment of the first page, or every page of your documents. Re-run reports at any page, and stop or start a print job at any time if you need silence.

Groups Similar Print Jobs for Maximum Efficiency.

PrintRite automatically groups types of printing jobs together (like spreadsheets, text, graphics and sideways jobs) for more efficient use of the equipment.

Spooled files are compressed to save disk space and prevent loss of data that can occur with other memory print buffers. PrintRite guarantees 100 percent protection of every bit of your data — even in the event of a power loss with its auto-backup.

New Laptop Users Can 'Print' — Without a Printer.

To your laptop computer, PrintRite looks like a printer. Your print jobs are spooled to disk and stored (compressed) in a DOS file. When you get to a printer, PrintRite will print the documents.

No Other System Supports up to FIVE Printers!

If you have printers dedicated to certain tasks — your laser printer loaded with letterhead, your daisywheel printing airbills, your dot matrix printing invoices — PrintRite allows you to select the appropriate printer for each item in the queue.

Print up to 85,523 Copies.

Longer runs are no problem for PrintRite.

Easy-to-Use Pull-Down Menus.

PrintRite's easy-to-use pull down menus allow fast, easy operation. The handy view screen displays the printing order of your documents. From this screen, you can quickly re-arrange the order in which your jobs will be printed — even stop or restart! PrintRite gives you more control with less work. And that means increased productivity.

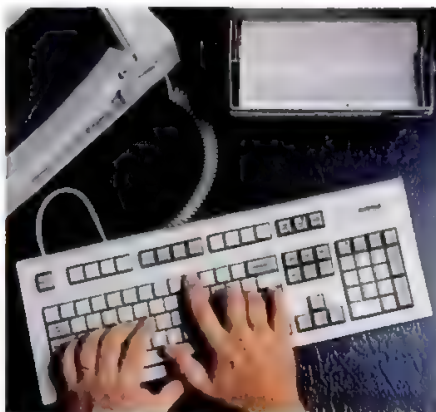
Supports Networks.

PrintRite lets you spool your print jobs in the network environment.

BLOC Publishing

PrintRite Just \$99.95

LW 4960 PrintRite 5¼" & 3¼" \$99.95
Runs on IBM PC, XT, AT, PS/2 and compatibles. Requires 50K memory. Will support virtually any printer.



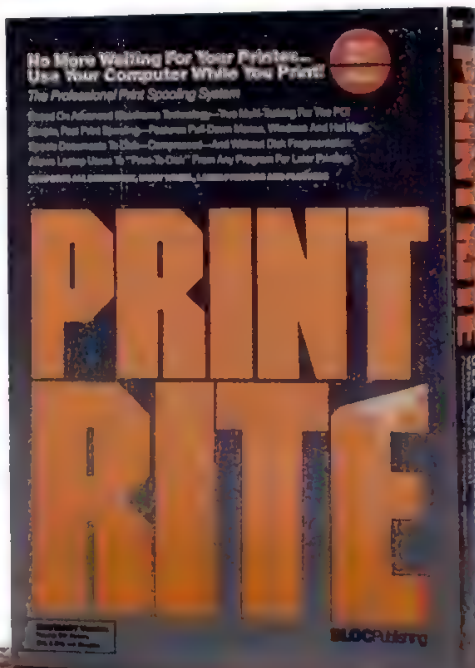
PrintRite Features:

- ▶ **Easy-to-Understand User Interface!** PrintRite's sleek interface makes it ready to use — right out of the box. Everything you need to know is contained in its convenient help screens and all functions are accessed by a pull-down menu system.
- ▶ **Queue Management with No Cryptic Commands.** While our competitors throw confusing abbreviations and highly technical terms at you, PrintRite uses plain English to describe its functions.
- ▶ **Fast "Hot Keys" Control.** PrintRite features built-in hot keys that make light work of your printed tasks. From anywhere, you can press a hot key to rearrange your printing order, or add a job to the queue, specify the number of copies you need, switch between printers — or stop printing.
- ▶ **Automatically Compresses Spooled Files.** PrintRite is the only product that compresses your spooled files, drawing on advanced mainframe technology to compress files and store them each in one file on the disk — this eliminates fragmentation and speeds processing time.
- ▶ **Portrait or Landscape on Any Laser Printer.** Only PrintRite allows you to select sideways printing for specific documents — with just a keystroke — from within any program. And you can instantly convert characters to support different laser printers' symbol sets. It also supports an unlimited number of printer drivers — with over 30 formats built-in!
- ▶ **Up to 225 Entries in Print Queue.** Continue to work while having up to 225 jobs in queue and printing!
- ▶ **Notepad Displays Show All Printing Activities.** PrintRite displays spool file names or source application names in the queue, the time and date for each entry, the status of each item to be printed, the total pages (or pages per file) to be printed, allows you to view any print task on screen — without having to print, and inactivate and reactivate any item in queue any time.

PrintRite features colorful, easy-to-understand screens along with convenient pull-down menus, windows and hot-keys.



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Express Your Thoughts Visually with Superior CADD Power — and Unusual Ease of Use.

Versatile and Precise, Generic CADD Level 3 Is a Powerhouse.

Learnable, Usable, Versatile, Precise.

CADD Level 3 is so easy to use that anyone can tap the power and precision of a true CADD program. Even first-time users can enjoy the benefits of computerized drawing — anything you can draw on paper can be drawn with Level 3. The program offers a structured yet flexible drawing environment with a variety of control, drawing, editing, and output options. You can learn CADD Level 3 fast and create professional drawings quickly.

You can draw with real-world scale in a variety of units of measure and take advantage of a level of precision and accuracy unavailable in paint and draw programs. Using vector and true floating-point graphics, your drawings can have precision to six significant digits.

For Anyone Who Needs to Express Thoughts Visually.

CADD Level 3 has the power to handle traditional CADD functions such as mechanical design, architectural layout, facilities layout, and electrical schematics.

But its ease of use also makes it ideal for new, less traditional uses. Use it to produce project schedules,

calendars, and merchandise floor layouts. Design flow and logic diagrams, charts, and business forms. Or create illustrations for use in desktop publishing programs.

The Basic Tools You'd Expect.

Level 3 replaces pencils, paper, rulers, T-squares, and compasses with powerful electronic equivalents. You create drawings by combining elements such as lines, points, polygons, arcs, curves and circles. Editing commands let you change, move, copy, mirror, rotate, and perform other functions with objects. You can zoom, use up to 256 layers, apply various units of measure, and use a variety of snaps and trims. And you can enter commands with simple two letter combinations, making CADD Level 3 fast and easy to work with.

The program also lets you indicate linear and angular dimensions instantly. Place dimensions horizontally or vertically to your drawing or aligned with objects in the drawing. And choose from a variety of fonts for both dimension values and text.

The Power Tools You Need to Work Most Effectively.

Generic CADD Level 3 provides advanced drafting tools for the most demanding projects. Global drawing and layer editing speed you through major changes. Dynamic dragging lets you see how components fit in



your drawing before you place them. Radial copying creates multiple copies of objects in a radial pattern — perfect for creating gears. And solid filling and cross hatching accelerates and simplifies the tedious task of filling in areas.

CADD Level 3 provides the ideal combination of ease of use and power. It puts the vast capabilities of true CADD into the hands of anyone who needs the highest precision in their drawings.

Generic
SOFTWARE
CADD Level 3 Just **\$279.95**
LW 1900 CADD Level 3 5 1/4" & 3 1/4" \$279.95
IBM PC or compatible, 640K RAM, DOS 2.0 or higher, 2 floppy disk drives or 1 floppy drive & 1 hard drive, graphics card (Hercules, color & monochrome, ATT 6300, CGA, EGA, VGA, and others)

THE SMART ALTERNATIVE TO CONVENTIONAL "TOP-DOWN" PROGRAMMING.

Object-Oriented Programming. More Power — Far Less Work.

Also an Ideal "Visual" Prototyping Tool — There's Nothing Like It!

Smalltalk/V

Smalltalk/V is an object-oriented programming system (OOPS). You program in Smalltalk by defining objects, their interrelationships and their behavior.

Smalltalk/V makes programming easy. It models the way you think and the way things really are. You solve problems by breaking them down into easily handled sub-problems and their interrelationships. You classify problems according to the similarities and differences to previously solved problems. And you re-use solutions of prior problems to solve new ones. Smalltalk/V makes programming a simple, logical process of building on the work of other solutions, off-the-shelf software, and existing systems.

- ☐ Compatible with Smalltalk/V 286, Smalltalk/V Mac
- ☐ Complete environment with graphics, overlapping windows, pop-up menus and mouse support
- ☐ Incremental program development capability
- ☐ Object-swapping virtual memory scheme that gets around the DOS 640K barrier
- ☐ Sophisticated source-level debugger window
- ☐ More than 100 classes and 2000 methods
- ☐ Three-part users manual

Smalltalk/V 286

Smalltalk/V 286 is Digitalk's powerful 80286 and 80386 PC-based object-oriented development environment. Its 32-bit architecture breaks the 640K DOS barrier to allow you to access up to 16 Mbytes of memory.

Smalltalk/V 286 runs in protected mode. It operates with DOS and soon will with OS/2. Smalltalk/V 286 is file compatible with Smalltalk/V and Smalltalk/V MAC.

Smalltalk/V 286 includes multi-tasking capabilities and integrated color graphics.

- ☐ Multi-tasking
- ☐ Runs in protected mode
- ☐ Portability among 8088/80286/80386 and Apple's Macintosh products
- ☐ Ability to have as many objects as memory will allow
- ☐ Supports objects larger than 64K bytes
- ☐ Complete environment with graphics, overlapping windows, pop-up menus and mouse support
- ☐ Integrated color graphics including a color palette window
- ☐ Powerful push-button debugger window with ability to set breakpoints, single-step through code and inspect and change objects
- ☐ More than 100 classes and 2000 methods
- ☐ Four part users manual



Smalltalk/V PM

Smalltalk/V® PM combines the power of the industry's leading object-oriented programming environment with the richness of Presentation Manager. Fully integrated into the PM environment, Smalltalk/V PM provides easy, complete access to PM objects, including windows, menus, dialog boxes and scroll bars.

Applications written in other Smalltalk/V environments can be ported to Smalltalk/V PM and will take on the look and feel of Presentation Manager.

Smalltalk/V PM also provides dramatically simplified access to the most complex Presentation Manager features. Dynamic Data Exchange (DDE) capabilities allow data to be 'hot-linked' to applications like Microsoft Excel with a minimum of programming. Any Dynamic Link Library call can be made from within Smalltalk/V PM.

- ☐ First fully compiled Smalltalk
- ☐ Generates standalone native code applications (.EXE)
- ☐ Portability to DOS and Apple Macintosh versions of Smalltalk/V



digitalk inc.

Smalltalk/V From **\$99.95**

LW 1800 Smalltalk/V \$99.95
LW 1810 Smalltalk/V 286 \$199.95
LW 1805 Smalltalk/V PM \$499.95

Please call for compatibility requirements.

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Software That 'Writes' Wills, Leases, Promissory Notes, and Other Binding Legal Documents.

Utilizes an Easy-to-Use 'Interview' Format!

Now you can produce binding legal documents for everyday legal situations without hiring an attorney. PERSONAL LAWYER will handle: General Power of Attorney, Special Power of Attorney, Revocation of Power of Attorney, Statement of Child Guardianship, Residential Real Estate Lease, Promissory Note and Personal Wills.

PERSONAL LAWYER works by asking you a set of questions related to your specific situation. The program will then ask subsequent questions, to follow-up, based on your original responses. Once the complete set of questions has been answered, PERSONAL LAWYER will compile the information, select paragraphs from a predetermined set within the system, and actually "write" an enforceable document for the circumstances you've described using its unique "text-builder."

This program has been developed under the supervision of attorney Douglas B. Jacobs, and the documents produced are legally binding. You could save thousands of dollars in legal fees by preparing documents yourself on your PC, quickly, easily — and inexpensively — with PERSONAL LAWYER.

► Last Will And Testament.

The importance of a personal will cannot be overstated and there are many reasons for having a will in today's society. You have undoubtedly worked very hard to acquire the property that you have, and it would be unfortunate if it were to go to persons who you would prefer not to benefit from your estate.

Without some careful thought to the distribution of your estate, it is possible that it might escheat (default) to the State or Federal Government, resulting in higher taxes and/or fees than necessary.

Perhaps most important is to remember those persons who you care about and who care about you, and adequately provide for them. Often, it is important to consider who is to take care of your children if you should die before they are old enough to take care of themselves.

This portion of the Personal Lawyer program permits you to bequeath general or special gifts. It also enables you to specify the executor of your estate, choose a guardian or guardians to care for minor children and make many other decisions for competent estate planning.

► Promissory Note.

Promissory notes provide the written ability to agree to accept a loan on certain terms and to define the payoff of the loan.

The promissory notes created by Personal Lawyer will be enforceable legally, and can be specifically designed by the user for maximum flexibility. If you have ever borrowed or lent money, you should have a written note outlining in detail the timing and method of payoff.

This program will create notes that are paid back with or without interest, with or without installments, with or without balloon payments, or even simple notes payable on demand. You can also write a note that is secured or unsecured and specify the type of security given.

In addition, specific information on all rights and obligations of both borrowers and lenders is provided.

► Power of Attorney

This program will help you write three very useful legal documents. It will allow you to write a General Power of Attorney, a Special Power of Attorney, and a Revocation of a Power of Attorney. They can give the power to take care of your assets, either generally or for specific matters.

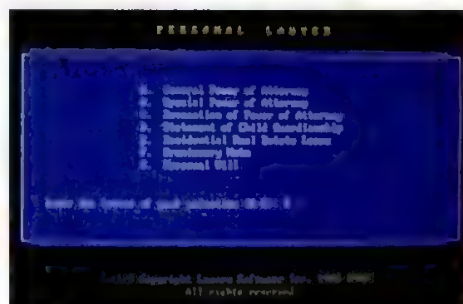
There are many times in one's life when you might want such a document; for example, it could be very helpful if you are leaving on a trip for a period of time and need to legally appoint someone to care for your interests while you are gone.

► Statement of Guardianship

This document authorizes temporary consent for certain situations. It can be used to give a neighbor or friend discretion to care for your children in your absence. Such a document is often useful to give your child's teacher or school the requisite authority to take the child on field trips and class outings. This program can be used to give someone general control or to give them only very limited and specific rights.

► Residential Real Estate Lease.

This portion of the program allows you to easily write a legally binding lease for such residential property as a house, duplex, apartment or rental condominium.



Personal Lawyer is designed for ease of use — from preparing your document to printing it. Each screen contains helpful information and references to the manual for more complete explanations. Shown here is the final screen; you can print to disk, print to screen — or both.



Simply type the answers to questions that appear on-screen. Personal Lawyer then "writes" the document for you.

If you have real property to rent as a residence, or you are a renter of such property, you need the protections of a written lease. Using this program carefully will allow you to provide numerous paragraphs to structure an enforceable legal document that describes all of the rights and obligations of both the landlord and the tenant.

You can create a lease that allows or disallows such items as: a security or clearing deposit, pets, payment of utilities by the landlord or tenant, parking privileges, etc. This will insure that the property is not improperly used or harmed, and that both parties are fully legally protected.

A Personal Lawyer for Family Matters.



Personal Lawyer Lifestyles allows users to easily address issues related to their relationship in a mature, informative manner. It's innovative "question and answer" format asks for specific information about your particular situation, offers help when needed, then automatically prepares the document. Export the document that you've created in Lifestyles to your word processing program for editing.

Personal Lawyer Lifestyles includes modules to create legally binding prenuptial, postnuptial, living-together and marital settlement agreements, as well as statements of guardianship.

(The PERSONAL LAWYER meets the requirements of 40 states and the District of Columbia — the state of Louisiana is excluded because much of its legal system is based on French rather than English law.)

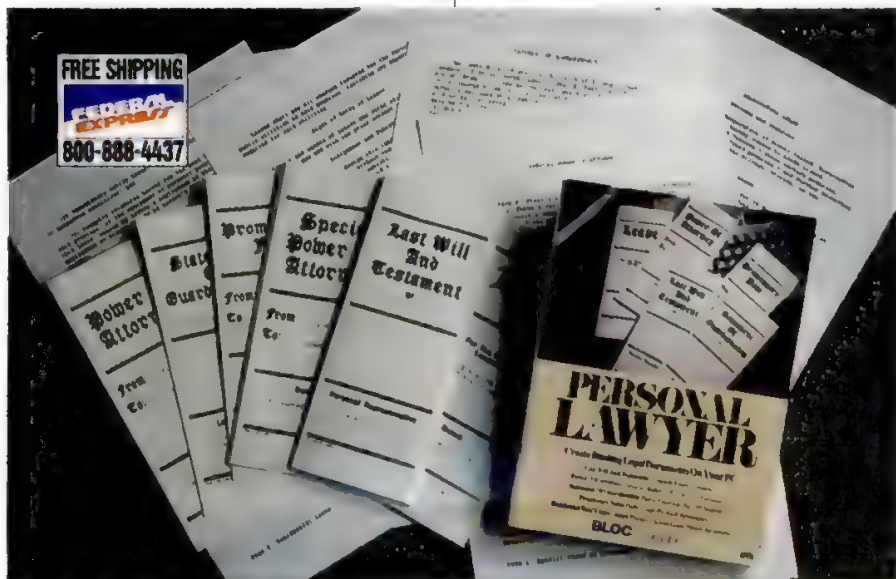
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Personal Lawyer Just \$59.95

LW 2250 Personal Lawyer 5¼" & 3¼" ... \$59.95

LW 2290 Lifestyles 5¼" & 3¼" \$59.95

Requires minimum 256K RAM. Supports color or monochrome and fully supports virtually ALL printers.



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Push VGA and EGA to the Limit, Higher Resolution, More Colors, Fonts!

UltraVision Unlocks the Hidden Power of Your Display!

Are you using the full capabilities of your VGA or EGA display? Probably not. The fact is, most software is designed to be compatible with a wide range of video systems, including older, less capable technology. As a result, even the most current versions of your favorite programs do not focus on higher-end video displays. That means your VGA or EGA display is being wastefully underused.

UltraVision fills this "video void" by giving your application software the ability to exploit advanced video technology. Awarded "The Best of 1989" by PC Magazine, UltraVision allows you to completely control screen colors, load alternate screen fonts, see more than 80 by 25 characters in many applications, experience breathtaking screen writing and scrolling speeds and enjoy un-

matched image clarity and crispness on multiscanning EGA monitors and all VGA monitors.

It's Not Magic — It's What You Paid For! EGA and VGA displays promised the ability to gain control of your visual environment. Color meant easier recognition; resolution meant better images and the ability to use actual screen fonts to enhance the design process. It's all there, but only UltraVision puts the power to use it in your hands — where it belongs.

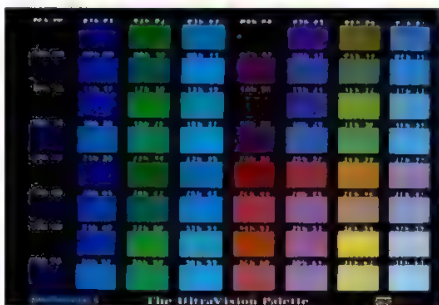
Goodbye, Drab Colors. Some programs force you to accept a predefined color scheme. Others may include color options, but usually the choices are no better than you'd get with an old-fashioned CGA monitor. UltraVision offers a simple,

effective solution to this problem.

UltraVision lets you redefine the screen colors used by most text and graphics-based applications. With 64 colors to choose from, the possibilities are nearly endless. UltraVision remembers your preferences, and even lets you save multiple color sets to suit different applications and lighting conditions.

Put on a New Face. Most EGA and VGA systems use a screen font borrowed from the original IBM Monochrome Display Adapter. Some video boards use a modified character style but the results are not always pleasant to look at. In either case, you're stuck with whatever font is supplied with your EGA or VGA system. UltraVision gives you a choice of 20 distinctive screen fonts.

Stop Scrolling Around. UltraVision lets you see more than 80×25 characters on screen in a host of popular applications. With several longer and wider screen sizes to choose from, you'll see more and scroll less. On EGA systems, you can choose screen sizes up to 132×44. On plain-vanilla VGA systems choose up to 94×63. On super-VGA systems like Video Seven V-RAM and Paradise VGA 1024 boards, choose sizes up to 132×60.



The UltraVision Palette — 64 vibrant colors!



FAT TABLETS ARE DEFINITELY OBSOLETE!

The Ultra Light, Ultra Thin Desktop Tablet.



Premier Digitizing Tablet and Input Devices for CAD and DTP

Sophisticated new graphics, CAD/CAM, business/presentation graphics and desktop publishing systems require a high degree of accuracy and precision movement. Without instruments that can provide this level of accuracy, you simply won't achieve clean, professional results. We tested dozens of input devices and digitizing tablets and recorded outstanding performances from the Numonics line of products. Specifically, GridMaster™ delivered full 1000 lines per inch resolution and accuracy to 0.010 of an inch. And GridMaster has mastered the technique of pen-tilt correction with their remarkably agile pen-stylus.

Convenience, Speed and Accuracy

The GridMaster Digitizing Mat is the most innovative tablet available. It's thinner (just 1/8"), lighter (weighs a mere 12 ounces), smaller (only 1 1/4" around active area for smaller footprint) than anything else we tested. It maintains absolute positioning and is easily user set up by either download commands or via a unique on-tablet setup menu. And GridMaster will actually "remember" configuration even when you turn the power off!

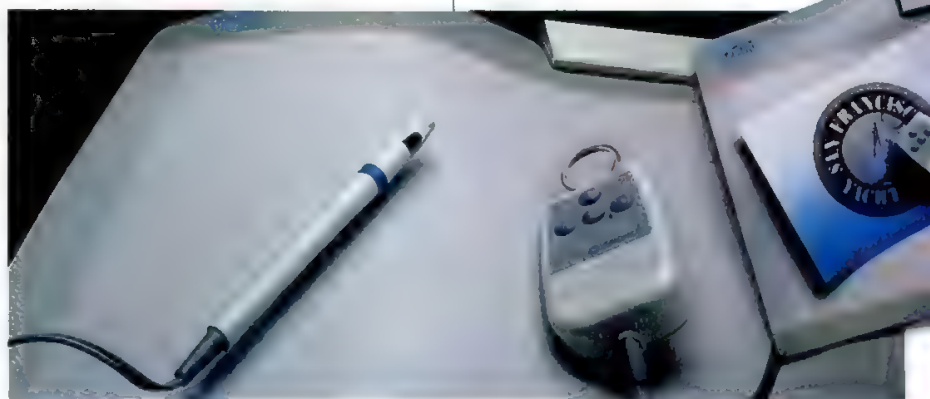
GridMaster is compatible with the IBM PC, XT, AT, and the Macintosh. And employing a sleek interface design, GridMaster allows fast emulation selections and a host of drivers (mouse, Windows, ADI, Macintosh).

The Complete Line of Tablets, Pens and Mice.

Although GridMaster will work with any device, it has been designed for explosive speed when used with the Numonics Pen Stylus and the Numonics 4 or 16 button cursor. Work as quickly as you like; GridMaster provides precise input any any speed.

Features:

- With cursor and on-tablet menu
- With host download commands
- Start up default conditions can be factory or user set
- Baud rate — user selectable
- Set-up utility disk includes diagnostics
- Interface: RS232C — 9 pin cable attached, and 9-25 pin adapter included.
- No power supply required
- Less cable clutter
- Both a side switch pen or a 4 button cursor included — only from Tiger



- Diagnostic LED indicator
- Resolution 1000 lines per inch
- Accuracy 0.010"
- Pen-tilt correction included
- RESOLUTION: The resolution of the system is 0.001" (0.025mm). The user can specify other resolutions, making it compatible with virtually all graphics software packages. Measurement in English or Metric units is selectable.

NUMONICS

GridMaster Just \$469.00

LW 1120 PC 12"x12" Working Area with Side Switch Pen Stylus & 4 Button Cursor \$469.00
LW 1130 MAC 12"x12" Working Area with Side Switch Pen Stylus & 4 Button Cursor \$469.00

All GridMaster PC Mats include the following: RS232C Cable, DB9 to DB25 Adapter, Instruction Manual, Set-Up menu Template, Utilities Diskette (5.25"). Diskette includes: Microsoft Mouse, Windows, & ADI Drivers, Tablet Setup Utility and Diagnostics.

The Proven Pathway To Financial Success...

...By Money Magazine — Includes **FREE** Quicken!

- ▶ **Do you have financial goals?** Are they achievable?
- ▶ **Does your money work** for you or do you work for your money?
- ▶ **Do you want a financial strategy** tailored to your family's needs and tolerances for risk?

Welcome to **WealthBuilder** by Money Magazine, a financial planning system that organizes your financial life. It helps you create personal financial objectives and then matches those objectives to a specific investment strategy which includes real products.

WealthBuilder by Money Magazine will guide you in saving and investing your money. Acting as your own personal financial assistant, the program will help you understand the long-term impact of your everyday financial decisions. You'll learn key financial concepts and goal setting. You'll be shown historical relationships between your investment options. Finally, you'll develop your own financial plan that suits your risk and return needs.

Just Press a Key...

It's easy to use. Results are fast. And you don't need to understand finance or computers. You only need to know how to press a key or point a mouse. The program does everything else.



WealthBuilder displays colorful charts that illustrate financial plans.

Professional Money Management.

A professional money manager calls a client's portfolio *optimized* when it mixes investments from different asset classes (such as equities, bonds, precious metals, and cash) in such a way that the failure of a few investments cannot ruin the portfolio, and in such a way that the overall portfolio is safe enough for the tastes of the client.

The careful choice of a balanced mix of investments is called *diversification*; the money manager's goal is an *optimized diversified portfolio*. The process of choosing investments begins with a thorough mathematical analysis of the historical performance of different classes of investments. The money manager uses computers to perform this analysis; it is mathematically very complex.

Gives Small Investors the Same "Striking Power" That the Big Guns Have!

Because this technique for optimization of a portfolio (known to professional investors as *asset allocation*) demands the use of powerful computers and the judgement of highly-paid investment professionals, it has generally not been available to small investors. But this technique is the heart of **WealthBuilder** by Money Magazine. No matter

how large or small your net worth may be, you will be able to construct a portfolio of optimally diversified investments that will theoretically offer you the greatest possible opportunity for growth within your personal tolerance for risk.

WealthBuilder Features Include:

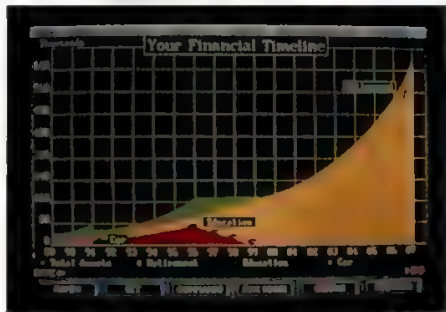
- ▶ **Tax Cutting...** provides you with tips to improve your cash flow through a lower tax bill.
- ▶ **Debt Consolidation...** automatically analyzes your liabilities structure for tips to lower expenses and improve savings.
- ▶ **Define Your Personal Goals...** plan for both short term and long term goals. Powerful modules are included for retirement, education, purchasing a home, insurance, and building your savings. A special feature allows you to create and analyze any personal goal.
- ▶ **Investment Planning...** through asset allocation, using up to 60 years of historical performance data on domestic and foreign stocks, bonds, cash, commodities, inflation, interest rates and economic growth to help you design an investment approach that is right for you.
- ▶ **Allocation Analysis...** fine tune your strategy by reviewing performance graphs and comparing your plan to other approaches and investment indices, such as the S&P 500 and Dow Jones Industrial.
- ▶ **Products...** analyze information on over 1400 mutual funds and 10,000 stocks and bonds; including quarterly, 1-, 5- and 10-year performance, the fund's investment philosophy, sales charges, minimum investment, where to call and how to buy.
- ▶ **Printed Action Plan...** a next step recommendation with listings on where to go to get specific products you need.
- ▶ **What-If...** I rent or buy a house? What if my spouse stops working? What-If Analysis allows you to change any information or assumption and immediately see the impact on your overall financial picture.
- ▶ **Financial Tutorials...** defines everything you need to know about your finances at the press of a key.
- ▶ **Quick Test...** builds your understanding of personal finance. Prompts you to review sections of the video tape and the financial tutorials.
- ▶ **Data Import...** can accept your existing financial data from Andrew Tobias' *Managing Your Money*™ and Quicken™.
- ▶ **Quarterly Updates...** you can subscribe to receive a quarterly update disk including the latest mutual fund and economic performance data.



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The Bottom Line: **WealthBuilder** is reasonably priced and eminently useful. —PC Computing
WealthBuilder plans your ideal investment strategy... and... stands out among financial programs. —PC Magazine



Creates financial timelines for your goals.

The program is by far the best... *Managing Your Money* requires too much work and will soon become a burdensome chore... **WealthBuilder** does a good job teaching you about money and money management. —Computer Currents



Now, Spend About 15 Minutes a Month Paying Your Bills!

Together with **WealthBuilder**, Quicken provides a complete financial solution. With this bundle, you have the opportunity to have the most powerful money management, investment analysis tool ever available! Imports data from Quicken into **WealthBuilder** to evaluate spending patterns and plan for your financial future.

REALITY

WealthBuilder Just \$199.95 with FREE Quicken 3.0 & Video

LW 1260 **WealthBuilder** 5 1/4" & 3 1/4" ... \$199.95
Runs on IBM PC, XT, AT, PS/2 and compatibles. Requires 512K, DOS 2.0 or higher and hard disk.

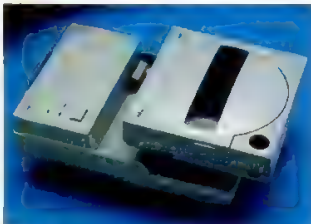
TIGER

Access Vast Amounts of Data Instantly. The Future Is Here!

Powerful, Affordable CD-ROM Technology — Put a Wealth of Information at Your Fingertips.

The early pioneers of computing couldn't possibly have imagined it. The ability to store vast amounts of information on a tiny plastic disk, and access any bit of it on demand. Then, insert it into documents and print it — all in just seconds.

This is the magic of CD-ROM (Compact Disc-Read Only Memory) technology — and now this giant leap carries a very modest pricetag. If you've got color display capabilities, you'll see dazzling graphics — in full color — right on the screen.



And when you're not using it to access information or graphics, the CDR-35 will play your audio CDs as well. Pretty versatile for such a little machine.

Introducing The NEC Intersect CDR-35 portable CD-ROM player. An amazing instrument. Weighing in at just 2.2 pounds the CDR-35 offers all the capabilities of full-size players at about half the price.

Quickly connect the CDR-35 to your IBM XT, AT or

PS/2 and read both 5-inch and 3-inch CD-ROMs, and the system comes complete with cable, software and interface card.

And talk about storage capacity...each CD holds up to 600 MEGABYTES (that's about 750 diskettes!) of fonts, photos and artwork.

This is the most advanced system for assembling professional newsletters, brochures, layouts, comps, ads and more.

Compact, Portable and Complete Flexibility.

- At 2.2 lbs., the CDR-35 connects to IBM XT/AT, PS/2, compatibles and Macintosh systems.
- Reads both 12cm (5") and 8cm (3") CD-ROMs.
- Local access to huge information stores whether you are at your desk or on the go!
- When you're not accessing data, NEC's award-winning audio expertise provides you with music from standard audio compact discs.
- You receive the NEC commitment to customer satisfaction, plus a nationwide network of dealers and factory authorized service centers to ensure it.



The Incredible NEC CDR-35!
Lightweight — just 2.2 pounds!

Engineered for Durability and Performance.

All of These Discs for Just ONE DOLLAR When You Buy the NEC CDR-35!

The New Grolier Electronic Encyclopedia

Critically acclaimed and widely used, *The New Electronic Encyclopedia* features the most current edition of *The Academic American Encyclopedia*. More than 30,000 articles enrich this highly regarded general reference work.

The entire text of a 21-volume encyclopedia (9 million words) are stored on a single compact disc. *The New Electronic Encyclopedia* allows searches by title, word, or phrase of the latest information on science, contemporary life, law, sports, and much more.

"If you're looking for a good research tool... *The New Electronic Encyclopedia* is well worth a look."

— PC Magazine 1/31/89

The Guinness Disc of Records

Find records instantly using your own search words: e.g., what record did Elizabeth Taylor break in the film *Cleopatra*?

Browse through the color picture gallery.

Learn from sections like *The Living World* or *Human Achievements*.

Choose whether to view photographs, listen to music and sound effects, or run an animation as you wish... the medium most appropriate to a particular record is used to provide you with as much information as possible... and it's all under your control.

WATCH — Animations illustrate how fast a jet flies or how tall the tallest man in the world is.

HEAR — the world's fastest backward talker in action.

SEE — Color Photographs of record-breaking feats — like a man eating a bike!

World Atlas — the World at Your Fingertips...

Atlas, almanac and world fact book in one, *World Atlas* gives you instant access to over 240 fully detailed, EGA/VGA color maps and a huge database of international information.

World Atlas is the perfect reference tool for travelers, educators, business people, librarians and students of all ages. This indispensable guide brings together the kind of important information that would take months to research on your own: government, inflation rates, climatic data, environmental information, economic indicators and more! Over 240 fully detailed, EGA/VGA color maps (including thematic, reference and regional relief maps). Plus, comparative data for every country in the world in five subject areas: geography, people, government, economy and communications. Includes thousands of international facts on over 70 different topics organized in easy-to-read, outline form.

The Software Toolworks — CD Game Pack!

The Chessmaster 2000 — Introducing the world's most exciting computer chess game — winner of the U.S. Open Computer Chess Championship two years in a row!

Bruce Lee Lives — You don't just play Bruce Lee Lives, you enter it. This true motion picture software lets you become Bruce Lee as you perfect the skill of martial arts.

Beyond the Black Hole — It's a bumpy ride! 35 different video games in one! Strap on your GrendoVision™ goggles and experience the most spectacular visual effects you've ever seen on a computer screen... true, stereoscopic 3-D!

Gin King-Cribbage King — Now you can play two of the world's most popular card games, in one complete package. Fantastic color; high resolution graphics; easy-to-use, menu-driven features.

Life & Death — It's not for the squeamish! In this awesome recreation of a bustling medical center, you will become a powerful surgeon! You will talk with your patient, read charts, order x-rays, ultra-sound, blood tests and other lab work. And when the time comes, you will have to pick up the knife!

Toolworks CD-ROM Software

LW9200 Guinness Book of World Records	 \$99.95
LW9205 CD ROM Game Pack	 \$99.95
LW9210 World Atlas CD ROM	 \$159.95
LW9215 Groliers Encyclopedia	 \$395.00

NEC CD-ROM Player

LW9220 NEC CDR-35 CD ROM Player \$798.00
Includes controller card, cables, etc. Specify XT/AT, PS/2, Apple, Mac, or Prospeed controller card and cable (included).

Get Software for \$1 More with Purchase of CDR-35 Player

LW9221 Buy Everything Above ONLY \$799.00
Save over \$750.00

Sorry, no returns except for defective replacements once used.

HURRY! THIS OFFER EXPIRES JULY 30, 1990.

To Order Toll-Free: (800) 888-4437 Int'l Orders: (305) 443-8212

FREE Federal Express Shipping!

See Order Form on Page 111

CD-ROM

Hundreds of Typefaces, Thousands of Photos and Images.



Compatible with popular desktop publishing packages.

Type Gallery™ — Available for PostScript® and HP LaserJet® Printers.

NEC Type Gallery is available in two type formats. The Type Gallery PS disc contains all 520 Adobe PostScript language fonts from ITC, Linotype AG and others. The Type Gallery LJ disc contains 76 AGFA PCL fonts which are compatible with HP (and compatible) LaserJet printers.

All 520 PostScript fonts are on a single compact disc. You can buy them all, for \$19.22 each, or just start out with 15 at \$26.60 each. If you purchase a license for 15, the rest of the library is on the disc and available for a license fee whenever you want to use them. For LaserJet fonts, 76 fonts are on the disc. Buy all 76 for \$1499 or a license for use of 12 for \$299.

Adobe® PostScript® Language Fonts Are Just \$19.22 Each.

You'll Pay \$46 Each Elsewhere!



Compatible with popular desktop publishing packages.

Image Folio™

Over 4,000 high quality digitized stock photos for internal use (PC). Stored in TIFF and WIN formats for high resolution and easy use. Retouching tools for manipulating photos through air brushing, cropping, resizing, reversing and changing light and color. Keyword search feature for easy reference and photo selection. Categories include Art Deco, Borders & Boxes, Business Graphics, Exercise & Fitness, Food, The Four Seasons, Newsletter-Maker, Religion, Travel, and much more.

Compatible with popular desktop publishing packages.



Image Gallery™

Up to 2,800 professionally hand drawn line art images from Metro Image Base, conveniently indexed by subject in 20 categories (PC & Mac). Images stored in TIFF and EPS file formats for high resolution and easy use. Disc includes the entire collection, along with access to six different image categories (600 images) with initial purchase. Unlock additional image categories as you need them by purchasing a password with one quick toll-free phone call. Disc also includes a comprehensive catalog for convenient reference and image selection.

Compatible with popular desktop publishing packages.



Photo Gallery™

Filled with 1,500 high quality digitized black and white stock photos indexed by subject in 20 categories (PC & Mac). Photos supplied by UNIPHOTO Picture Agency for internal use. Gray scale TIFF file format for simple placement and manipulation. Includes a comprehensive catalog for reference and photo selection.

Assurance of high quality and extensive selection of photos exclusively supplied by UNIPHOTO Picture Agency, a leader in the stock photography industry. Full compatibility with Apple Macintosh and with IBM PC or 100% compatibles that support TIFF file formats.

Photo Categories:

- Abstract
- Agriculture
- Animals
- Buildings
- Construction
- Corporate
- Energy
- Finance
- Medicine
- People
- Scenics
- Sports

Type Gallery, Image Gallery, Photo Gallery and Image Folio are trademarks of NEC Technologies, Inc. LaserJet and PCL are registered trademarks of Hewlett-Packard Corp. Macintosh is a registered trademark of Apple Computer, Inc. IBM, PC, XT and AT are registered trademarks of the International Business Machines Corporation.

Compatible with popular desktop publishing packages.



Clip Art 3D

Over 2,500 full color, three dimensional images in more than 50 different subject categories (PC & Mac). Editing tools are included that allow you to change color (16 million choices), position, size, shape, perspective and lighting. Images stored in multiple formats, including TIFF, EPS, PICT, and WMF. Disc also includes a comprehensive catalog for reference and clip art selection.

The NEC Graphics Library Super CDeal Only From Tiger!

All Our Software & A CD-ROM Player Only \$977!

LW9200 Guinness Book of World Records	\$99.95
LW9205 CD ROM Game Pack	\$99.95
LW9210 World Atlas CD ROM	\$159.95
LW9215 Groliers Encyclopedia	\$395.00
LW9220 NEC CD35 CD ROM Player	\$798.00

And your choice of any ONE of the following:

LW9230 Type Gallery PS, any 15 PostScript fonts	\$399.00
LW9240 Type Gallery LJ, any 12 LaserJet fonts	\$299.00
LW9255 Clip Art 3D, 2500 color graphics images	\$399.00
LW9260 Photo Gallery, 1500 stock photos	\$399.00
LW9265 Image Folio, 4000 color stock photos	\$399.00
TOTAL VALUE	\$1951.85

EXCLUSIVE TIGER PACKAGE Only \$977.98

Includes controller card, cables, etc. Specify XT/AT, PS/2, Apple, Mac, or Prospeed.

Sorry, no returns except for defective replacements once used.

HURRY! THIS OFFER EXPIRES JULY 30, 1990.

NEC CD-ROM Software

Adobe® PostScript® Language Fonts - Only \$19.22 ea.

LW9225 Type Gallery PS Premium, 520 fonts	\$19.22
Total for all 520 PostScript fonts	\$9,995.00

Includes FREE NEC CDR 72 CD Player & Clip Art 3D worth \$1,600!

LW9230 Type Gallery PS, license to use any 15 fonts	ea. \$26.60
Total to use any 15 of 520 fonts	\$399.00

HP LaserJet® (AGFA® PCL®) Fonts - Only \$19.72 ea.

LW9235 Type Gallery LJ Premium, 76 AGFA PCL fonts	ea. \$19.72
Total for all 76 AGFA PCL fonts	\$1,499.00

Includes FREE Image Folio & Clip Art 3D worth \$798!

LW9240 Type Gallery LJ, use any 12 fonts	ea. \$24.92
Total to use any 12 of 76 fonts	\$299.00

Graphic Art & Photography on CD-ROM

LW9245 Image Gallery Premium, 2800 Metro Images	ea. \$0.32
Total for all 2800 Metro Images	\$899.00

Includes FREE Image Folio & Clip Art 3D worth \$798!

LW9250 Image Gallery, any 600 on CD	ea. \$0.67
Total to use any 600 of 2800 images	\$399.00

LW9255 Clip Art 3D, 2500 color images	\$399.00
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LW9260 Photo Gallery, 1500 stock photos	\$399.00
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LW9260 Image Folio, 4000 stock photos	\$399.00
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CIRCLE 515 ON READER SERVICE CARD

JUNE 26, 1990 PC MAGAZINE **103**

Get Up To 32Mb of Expanded Memory — Without Buying Any Hardware!



Above DISC 3.1 — Converts Extended Memory or Hard Disk Space Into Expanded Memory — For Just \$99.00.

Break the 640K Barrier with Above DISC 3.1

Now you can run memory-hungry applications like spreadsheets, large desktop publishing and text files, Windows, "new-generation" TSRs — even more sophisticated CAD drawings — *without buying any new hardware — saves expansion slots!* Ideal for laptops.

Above DISC 3.1 utilizes previously unused portions of your Extended Memory located on the motherboard — *OR employs your hard disk — to simulate EXPANDED Memory.* It accesses up to 32 megs of paged memory and supports EMS 3.2 & 4.0.

You could spend \$1000 for just ONE MEGABYTE of Expanded Memory — or you could buy Above DISC — *and get up to 32 MEGS — for just \$99.95!* If you use a PS/2 with 1 or 2 megabytes of Extended memory, and want to fully utilize it — or you'd like to increase the RAM capacity of your current PCs, XT's and AT's — Above DISC is the ideal, *inexpensive solution* (without sacrificing precious expansion slots). Installs in seconds.

Above DISC Turns Your Hard Disk Into Expanded Memory!

Above DISC seeks out all the memory available on the motherboard beyond 640K, all the RAM on your extended memory board (much of it completely unused), or up to 32Mb of memory on your hard disk and uses it to simulate expanded memory. So you'll use memory you simply never had before — *to run faster, more powerful, applications and create larger spreadsheets, drawings or databases.*

Compatible with These Applications:

- Lotus 1-2-3, release 2.01 and 2.2
- Lotus Symphony 2.0
- Quattro 1.01
- SuperCalc 5 Revision B
- Microsoft Excel 2.1
- WordPerfect 5.0 and 5.1
- Aldus Pagemaker 2.0
- DataEase 4.0
- Enable QA 3.0
- Quattro Pro
- Zsoft's Publisher's Paintbrush
- Generic CADD Level 3
- On 386 machines only:
- Microsoft Windows/286
- Xerox Ventura Publisher
- IBM Displaywrite 4

CLOSE-UP

Why RAM Expansion?

Most AT and PS/2 compatible personal computers are purchased with additional memory or can accept additional memory. Allowing the user to use more than 640Kb was one of the major selling points for the AT-style computers. It is now common for an AT-type computer to come standard with 1024Kb on the motherboard alone.

Unfortunately, PC/MS DOS cannot make use of this additional memory directly, as well as the application programs running under DOS. This type of additional memory is called *EXTENDED* memory, and it is most commonly used as a RAM disk, for print spooling, or with other utility programs designed for a specific, non-application oriented task.

Why? Because many software application programs running under PC/MS DOS, such as spreadsheets, word processors, and data bases, use some RAM memory.

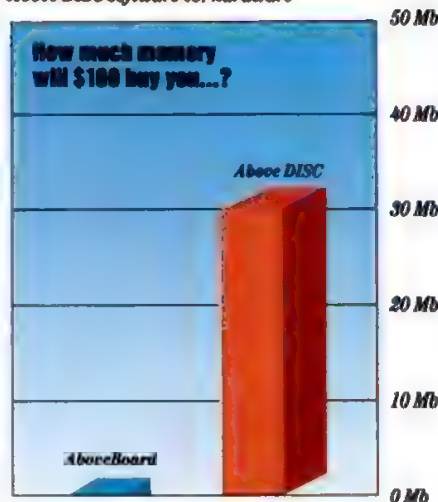
When users began experiencing memory limitations from overcrowded base memory (the lower 640Kb), Lotus, Intel, and Microsoft came to the rescue with the LIM EMS 3.2 specification for hardware based EXPANDED memory. Since then, the specification has been updated to EMS 4.0 (LIM EMS is the abbreviation for LOTUS/Intel/Microsoft Expanded Memory System). Users could have spreadsheets 2 megabytes or larger by using this expensive hardware based EXPANDED memory solution.

Why Pay the Astronomical Price of Memory Boards?

...When for just \$99.95 you can simulate Expanded Memory — and get the same fast, smooth performance as with expensive hardware. Here's a comparison of Above DISC software vs. hardware.

Megabytes per 100 Dollars

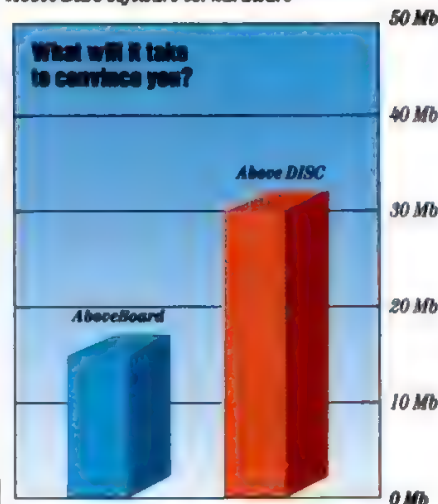
Above DISC software vs. hardware



You'd spend up to \$1000 to equip your system with Intel's AboveBoard — and get ¼ meg of Expanded Memory per \$100, vs. Above DISC's 32Mb!

Potential Capacity

Above DISC software vs. hardware



With the Intel board, you're limited to 16 Mb of Expanded Memory. With Above DISC, you can gain up to 32Mb and use the larger programs!

Above DISC Features:

- ▶ 32 megabytes of EMS memory.
- ▶ Supports the Lotus, Intel, Microsoft EMS 3.2 and 4.0.
- ▶ Compatible with all versions of DOS 3.1 and higher.
- ▶ Supports all existing IBM PC or compatible processors and busses (8088, 8086, 80286, 80386).
- ▶ A new self configuring installation means you can be using your new memory in less than three minutes.
- ▶ Menu-driven installation program.
- ▶ Fully-reconfigurable without rebooting.

So, before you trash your extended memory card or non-expandable machine, get Above DISC, the most incredible software to come along in years.

NEW! Memory Management Features:

- ▶ AboveLAN: Moves Novell LAN network drivers (36K) to extended memory
- ▶ AboveMEM: Increases speed and memory (64K) for Lotus 1-2-3 (2.01 & 2.2) users
- ▶ Above640: Increases conventional memory to 736K on systems with EGA/VGA video adapters
- ▶ Disk Spillover with Cache when emulating from hard disk

NEW PRODUCT! AboveLAN

More RAM Space & Higher Performance for Your Novell LAN! AboveLAN is a feature-rich memory management utility which gives Novell LAN users more RAM space and higher overall performance, saving up to 152K of conventional memory on each workstation.

- Loads Novell NET3.COM or NET4.COM into the first 64K of extended or expanded memory — saving 36K of conventional memory.
- Loads NETBIOS drives only when required and unloads them on command with no need to re-boot.
- Above640 feature increases conventional memory by 96K on systems equipped with EGA or VGA, when out of graphics mode.
- Instant self-configuring installation.
- UNLIMITED USERS PER SINGLE FILESERVER.

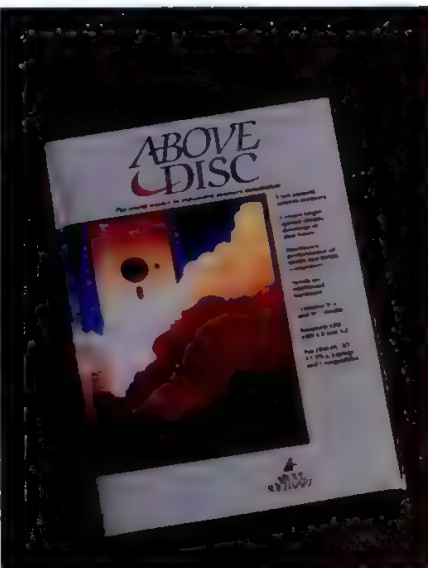


Above DISC 3.1 Just \$99.95 Memory Manager

LW 6550 Above DISC 5¼" & 3½" \$99.95

LW 6551 AboveLAN \$495.00

Runs on IBM PC, XT, AT, PS/2 and compatibles. Requires 512K memory. Uses as little as 14K of lower 640K memory. MS-DOS or PC-DOS, version 3.1 or greater.



The Only Way to Accurately Fill-In Pre-Printed Forms.

Fill-In Any Form Regardless of Its Complexity.

Here's an interesting fact: Of the total cost to produce, process and archive a form, 4 percent is devoted to creation, 8 percent to archiving, and 88 percent is devoted to filling it in and processing it. Clearly, filling in forms is a time-consuming, tedious task. Waste, error and inefficiency can grind the flow of information to a halt, and cost thousands of dollars in time and unproductive work.

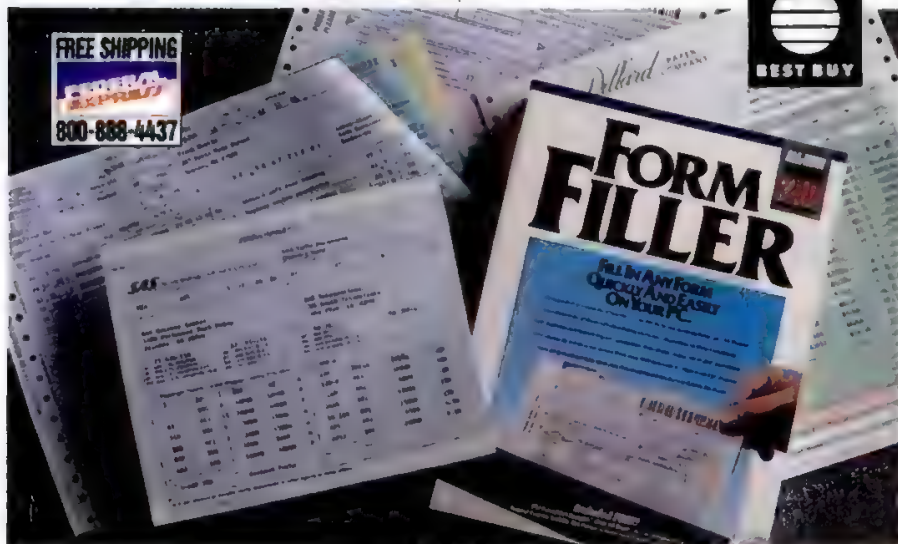
FormFiller is the only system specifically designed to accurately fill in forms with pinpoint-precision. It contains a host of features that streamline the process—and it can handle any form, including multi-page, double-sided and interleaved carbon forms, while providing over

40 math and financial functions for use within the form. No other system available provides the power and flexibility of FormFiller.

Unmatched Math and Financial Functions.

FormFiller has a complete set of math and financial functions that can actually perform calculations for you, then automatically enter totals.

July 1989, PC World



40 math and financial functions for use within the form. No other system available provides the power and flexibility of FormFiller.

FormFiller supports virtually any hardware configuration, and is perfectly at home without a graphics adaptor, or any additional equipment. You'll breeze through invoices, insurance and medical forms, shipping airbills, government, legal and industrial forms in a fraction of the time you're spending now.

Here's How FormFiller Works.

FormFiller begins by printing a grid on your pre-printed form. From this grid, FormFiller creates a "master template" of your form, and establishes positions for each blank on the form. The form is then represented on the computer screen, providing a friendly, "word-processor-like" feel for data entry personnel. You can insert non-printable notes to guide data entry, and create custom help screens for any situation that may arise. To fill in the form, simply call the template, insert the pre-printed form into your printer, and tab from blank to blank—each entry will appear in exact position. When data entry has been completed, FormFiller will check the form for completeness and accuracy.

FormFiller is the only system that synchronizes your computer and printer for exact positioning anytime you print the form.

FormFiller also contains a convenient "look-up" table that can store and instantly retrieve frequently repeated information (like part numbers, customer codes, wholesale and retail prices, etc.). A couple of simple key-strokes, and FormFiller will instantly find the data you need and automatically enter it into the proper position on the form. And FormFiller can handle an unlimited number of fields per page.

Powerful Import Capabilities.

FormFiller will quickly import/merge/export information from your database or spreadsheet (dBase II, III, Lotus 1-2-3, WKS, WK1, ASCII), eliminating time-consuming re-entry of data, without conversion. Now, you can virtually fill-in forms directly from your database, or export data gathered by your forms back to your database.

for you. For example, numbers or prices appearing in fields you specify can be totalled, a conditional discount can be automatically figured and deducted, and the grand total will be automatically printed into position. If one number changes, FormFiller will instantly recalculate, and re-enter the new values. Calculate percentages, loan and amortization amounts, depreciation, present and future values—dozens more.

Full Printer and Attribute Support.

Any font, attribute or format you need is supported by

FormFiller. And it now offers full support for the Hewlett-Packard LaserJet Series II Duplex printer.

In addition, FormFiller sports a new 200 column by 300 row work area for easy viewing and rapid movement throughout the form.

FormFiller Features:

- ▶ **Precise Spacing Control.** FormFiller allows pinpoint-precise spacing for absolutely any form. Since most forms were designed to be filled in by hand, they do not share a standard spacing pattern. This makes typewriters, or word processors on a PC simply inadequate to do the job efficiently. FormFiller can adjust spacing in any direction, with accuracy as fine as 1/720th of an inch.
- ▶ **Designed To Make Data Entry Simple!** FormFiller features a friendly word-processor-like environment. Data entry personnel simply tab from blank to blank. Even novice computer users can quickly enter data, prompted by help screens and on-screen notes.
- ▶ **Data Formatting Speeds Fill-in Time.** For example, you can simply type "1234567890" and FormFiller instantly formats it as: "(123) 456-7890." You can format all information to refine data-entry to a minimum. Includes auto-centering, left and right alignment, forced upper and lower case, copy or repeat data and more. Contains over 100 date formats.
- ▶ **Expanded Printing Capabilities.** FormFiller 2.0 features support of virtually any printer, including the Hewlett-Packard Series II Duplex printer. New extended character and line-printing controls, built-in letter-quality support and full printer font support.
- ▶ **Extensive Math & Financial Features.** Dozens of spreadsheet-like math and financial functions are available for use within the form. Specify certain entries to be added and FormFiller will automatically fill-in the correct sum into the appropriate blank on the form. Advanced math features include: interest, annual percentage rate, depreciation, principal, exponents, present/future values and more. Includes conditional "if-then" testing to automatically figure and deduct discounts.
- ▶ **FormFiller Sampler.** Includes over 40 ready-to-use templates! Just pop a Federal Express form into your printer — and fill it in!

BLOC Publishing

FormFiller 2.0 Just \$149.00

LW 8002 FormFiller 5 1/4" \$149.00

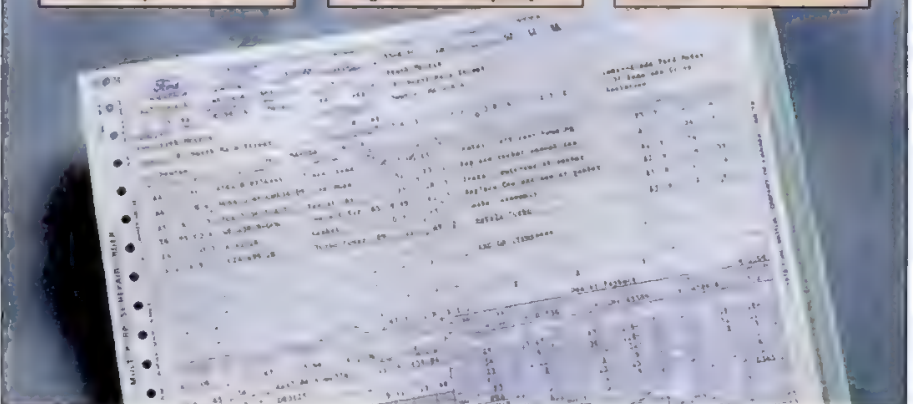
LW 8120 FormFiller 3 1/4" \$149.00

IBM PC, XT, AT, PS/2 or compatibles with 512K, DOS 2.0 or greater and 2 floppy drives, or one floppy drive and a hard disk. Supports virtually all printers. Includes "The FormFiller Sampler"—sample templates, user guide, help cards and spacing grid.

Fast Data Entry: This form requires specific part numbers and other cost codes. FormFiller can store this data, retrieve it and insert it -- in position -- on the form, instantly.

Multi-Part Forms: Each form has unique requirements. This form contains carbon "patches" and several parts. FormFiller's template allows fast fill-in of any form -- regardless of its complexity.

Extensive Math: No other system could perform the calculations required for this form. FormFiller contains over 40 math and financial functions. It's fast -- and error-free!



Now You Can Download Reports From Any Mini or Mainframe and Bring the Data Alive on Your PC!

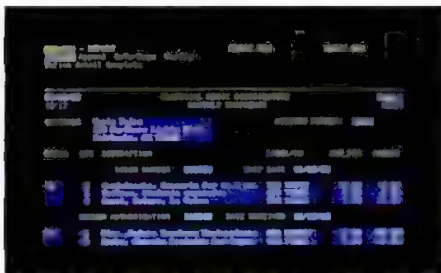
New! Monarch Reads Report Files, Extracts the Data, and Gives It Back to You Formatted Any Way You Want.

Consider for a moment the vast ocean of information that governments, corporations and other organizations around the world accumulate, store and manage. Every day, billions of bytes of new information are added to the pool. If handled with thoughtful care, this information can be a priceless resource.

The sheer volume of information demands a mainframe or mini-computer for data storage. But here's the paradox: All the best tools for data analysis are on the PC. PC users who need to get their hands on the data cannot gain access to it. They must sift through stacks of printed reports to find what they want. Now, for the first time, there's a remarkably intuitive new tool to help PC users bridge the data gap.

Existing Reports Become Valuable, Ready-Made Databases.

Monarch reads computer-generated reports and extracts the data! To understand the magic of Monarch, picture all the reports that come across your desk. All those cost summaries, transaction reports, customer lists, asset schedules, payroll reports and more. Think of flipping through all those pages trying to understand what's going on. Imagine trying to rekey all that data into your spreadsheet for analysis. With Monarch, the data comes alive.



Monarch reads report files and extracts the data. Here, the extraction template overlays the report.



The data is assembled into records, selected, summarized, and sent out to Lotus 1-2-3.

Monarch can read any report downloaded from a mainframe or mini-computer. (Or generated on a PC.) It extracts data from the report file and serves it up any way you want. You can see it, sift it, select it, summarize it and send it out to your spreadsheet, word processor, graphics package or database man-

ager. Monarch can read any report stored on disk, including ASCII files, TXT files, PRN files and SDF files.

Why Read Report Files?

Computer-generated reports are the life-blood of modern business. Tremendous resources have been invested in designing reports and delivering them into the hands of managers. Monarch can give you an immediate return on that investment. Monarch's ability to read report files, extract data, and then manipulate and analyze the results, make all your existing reports more valuable than ever.

Monarch can read reports generated in nearly all computing environments, including IBM, DEC, NCR, Unisys, Wang, ICL and many others.

CASE STUDY: The Agency of Printed Reports...

Suppose you've got a 500-page customer activity report that's been downloaded from your company's mainframe. You've been asked to analyze sales trends, but you don't want to spend hours digging through the printed report. Monarch allows you to automate the analysis by turning the report into a live database.

Here's how it's done. Simply load the customer report file into Monarch, quickly define a data extraction template, and then explore the report using powerful data analysis commands.

You can tell Monarch to show you all the sales transactions for a particular customer, product, salesman or region. Then produce crosstab summaries that show the field totals and record counts broken out in a variety of useful formats. Data and reports can be output on a printer, or exported to applications like Lotus 1-2-3.

CASE STUDY: Adding Flavor to "Plain Vanilla" PC Reports.

In the PC environment, accounting systems aren't very adept at producing anything but "standard" reports. Monarch makes accessing and analyzing this information fast and simple. Monarch will actually capture a report while it's being printed, extract the data, and reformat it according to your particular specifications.

"Monarch is the slickest thing I've seen in a long time. It has already saved me lots of sweat and toil and enabled me to work smarter."

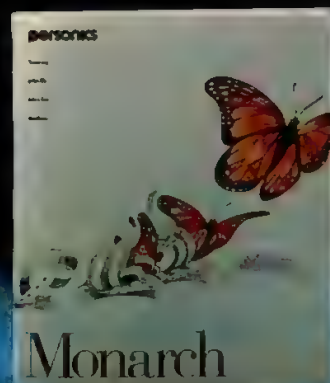
—Bob St. James, Loctite Luminescent Systems, Inc.

personics

Monarch Just \$495.00

LW 1002 Monarch 5 1/4" & 3 1/4" \$495.00
IBM PC, XT, AT, PS/2 and compatibles with 512K Hard disk recommended.

Turns a Report File into a Ready-Made Database.



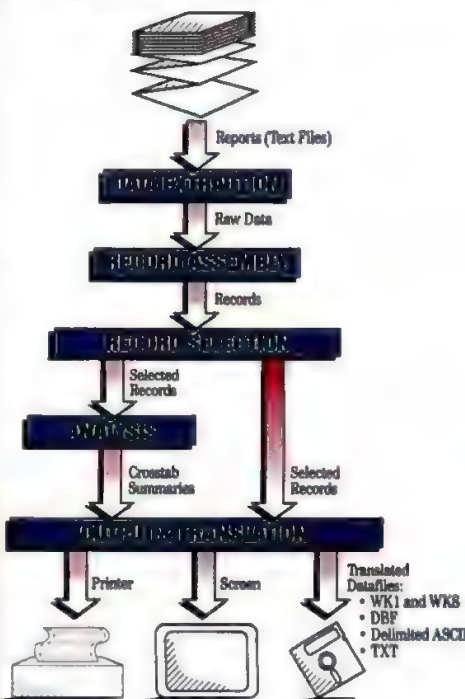
Here's How Data Flows Through Monarch...

Report files are input to Monarch where data is extracted and assembled into database records. The records are then passed to the record selection module for filtering. Only those records that meet the selection criteria (that you define) are passed on to the analysis and output modules.

The analysis module is used to generate summary reports about the data. Its basic function is to count records and sum numeric fields. It can generate simple tabulations as well as two-dimensional and multi-dimensional cross-tabulations that show interactions among variables.

The output module is responsible for sending output to the screen, to your printer or to disk. When output is sent to disk, it can be translated into a variety of formats recognized by most leading spreadsheets, word processors, graphics packages and database managers.

Monarch is like two products in one: It combines features of a super-sophisticated data translation utility with the query and analysis power of a full-fledged database manager.



Are You Burned Out on dBASE?

Experience a New State-of-the-Art User Interface, Language Enhancements, High Performance Functionality...

"Sure dBASE has its drawbacks and it's tough to use, but I've got a lot invested in it..."

While most businessmen and managers enjoy the enormous benefits of using dBASE III Plus to manage their database, they also tangle with the problem of learning curves. Some tasks are so complex, they're simply never used. For the programmer, the system contains some very serious limitations. But dBASE is a wide-spread corporate standard...

The answer is dBLX, the amazing dBASE III Plus superclone that's easier to use and more capable than dBASE, while extending its power and scope of functionality. dBLX's advanced new interface makes working with it simpler for novices and faster for experienced users and programmers. And dBLX is completely compatible with dBASE, so you can access the same data files, reports, programs and index files using the same command structure. dBLX puts performance into those areas that dBASE doesn't touch. Like its remarkable new interface that includes true windowing, sophisticated language extensions and built-in charts and other graphic devices. dBLX provides useful tools to store, manipulate, retrieve and perform in-depth analysis of data. Programmers using dBLX will discover enhancements such as multi-dimensional arrays, user-defined functions, automatic memory swapping, "C" language interface, the ability to create complex multi-file relationships, and a unique Fix Option that streamlines debugging.

"What if I Want to Implement a Network, or Even Move to UNIX?..."

dBLX provides pathways to networks and other operating environments. Your applications and files can be easily moved to the UNIX environment to quickly harness the productive power of this multi-user platform. You can even integrate your databases with a number of SQL database servers.

dBLX Delivers More dBASE than dBASE...

dBLX outruns the program it was patterned after. That's rare in the software business. Windowing, for example, allows dBASE programmers, for the first time, to create, move, size, overlay, remove and restore windows. Pop-up help screens and menu selection bars can be quickly inserted into applications. In addition, dBLX allows simultaneous comparison of two or more databases on your screen. For good measure, dBLX offers full support of EMS — automatically using it to open database and index files. This allows much greater programming flexibility and faster program execution.

Friendlier and more powerful, dBLX picks up where dBASE leaves off...

Full File Compatibility with dBASE

Data files, index files, programs, reports, and format files are all fully compatible with dBASE. dBLX and dBASE can use the same databases and run the same dBASE programs.

Full Syntax Compatibility with dBASE

Users familiar with dBASE syntax will be completely comfortable with dBLX. They need learn only those commands which dBLX adds to the language.

Full DOS Compatibility & EMS Support

dBLX will run on MS-DOS based computers, whether IBM compatible or not. dBLX will automatically take advantage of expanded memory for opening database and index files. This allows greater programming flexibility and faster program execution.

Automatic "Memory Swapping"

dBLX can swap a program from RAM to disk prior to running a word processor, spreadsheet, or other program from within an application. This capability is currently not available in other dBASE language products.

Fully Integrated Online "Help" System

Users can use the F1 key to call two levels of context-related Help and a full online manual. New and experienced users alike can get immediate help for any problem that might arise.

Macro Creation

dBLX adds a high level keyboard macro capability as part of INTRO. The use of macros allows you to record a history of your menu choices and save them as dBASE commands in a special program file. Later, "replay" a command sequence with as few as four keystrokes.

Improved Error Messages

Two levels of error messages give the user the ability to see a full screen of specific information about any error. This avoids the frustration caused by cryptic, uninformative error messages.

Enhanced Text Editor

dBLX has an enhanced MODIFY COMMAND text editor. This editor offers such useful features as block read, write, and move, on-line help, and string searches. File size is limited only by available memory.

Improved Memo Field Handling

dBLX handles word wrap, memo line count, memo field format line by line, and replacement of the contents of a memo field with the contents of an array. These additional capabilities make it easier to create applications that deal with large amounts of text.

Records in dBLX can contain up to 512 fields, or default to the dBASE-compatible limit of 128 fields.

Graphs

dBLX lets you easily create and display 6 kinds of graphs and charts using dBASE data. Graphs can be printed directly or exported to desktop publishing products like Ventura Publisher and Pagemaker.

Windowing & Multiple File Relationships

A dozen new dBLX commands add true windowing to the dBASE language. Programmers can create, size, move, overlay, remove, and restore windows. These commands make it easy to create pop-up help screens and menu selection bars. It is also possible to simultaneously compare two or more databases on screen.

dBLX allows multiple relations to be set beyond the standard dBASE capabilities. Many parent to child, as well as child to parent relations can be made.

User Defined Functions

dBLX lets you customize the dBASE language. You can define your own functions, which may be called as a standard element of the dBASE language. These user-defined functions are so easy to use that you'll quickly expand the scope of your work!

Fix Option

"Fix" is one of the options available when a user encounters a program error. It automatically invokes the text editor and places the cursor on the offending program line. After the error is corrected, dBLX resumes program execution at the changed line — saving considerable time in the debugging process.



The Amazing New Programming Language That "Out dBASE-es" dBASE.

CLOSE-UP

New Commands

- ▶ **@...SAY...GET...VALID** <logExp>: Ideal for automated data validity checking. Forces fulfillment of the VALID expression before leaving the GET field. Expression may contain a User Defined Function.
- ▶ **@...SAY...GET...HELP** <charExp>: Perfect for context-sensitive help. Specifies what will appear in a programmer-defined window when the GET is active and the user presses F1. The expression may contain a User Defined Function.
- ▶ **DOSINT**: Enacts a specified DOS interrupt, passing, and returning register values via memory variables.
- ▶ **SAVE STATUS**: Saves the status of all SET commands to a disk file. The RESTORE STATUS command restores the original operating environment from this file.
- ▶ **SET KEY**: Specifies a program or procedure that dBLX should execute when the specified key is pressed. Up to 32 different function and control key combinations can operate as "hot keys."

WORDTECH SYSTEMS, INC.

dBLX Just \$199.95

LW 5030 dBLX 5 1/4" & 3 1/4" \$199.95

Requires a min. of 480K TPA (RAM free of the operating system, device drivers, and any other memory resident software). For most systems, this will entail a min. of 512K RAM. dBLX will use 64K of EMS (when avail.). Requires MS-DOS or PC-DOS 2.0 or later.

"As a former dBASE user, I felt the frustration of its limits. With dBLX, I can do just about anything I can imagine. The interface is sharp and logical; the windowing is an exceptional new feature."

—Alexis Fernandez
Miami, Florida



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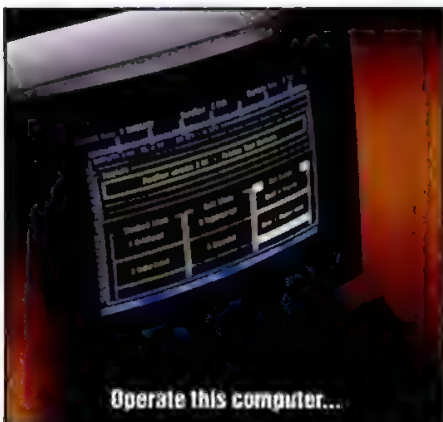
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It's Time to Get Serious About Remote Computing!

CO/SESSION allows you to quickly connect your computer to a distant PC (on a phone line) and run that remote computer as if you were right there — at the keyboard! From a laptop in a hotel room, you can control your PC back at the office — even if it's more powerful — provide training, or troubleshoot a customer's system from your office.



You can even print documents on either, or both systems simultaneously. And CO/SESSION 4.0 includes an all new "windows-like" interface for speed and convenience, plus error-checking, seven advanced new security features, EGA, VGA and Hercules support (for graphics) and much more.

The best package available for remote computing, remote customer support, background file transfers and remote network access. Easy to use — just install it — CO/SESSION sits in the background using only 51K.

And CO/SESSION transfers files up to 20 percent faster than even its closest competitor — with screen updates over 400 percent faster!

Examine the Tremendous Advantages of This Easy-to-Use Critically-Acclaimed Remote Control Package.

The future of computing hinges on the concept of connectivity. The ability to access computers from a remote location opens a world of productivity that until now, has been unimaginable.

CO/SESSION runs in the background of both machines until called up by using hot keys. Both the remote (your computer) and host computer (the computer you're calling) can initiate calls using the convenient dialing directory. You'll control the distant PC with speed, safety and convenience. And CO/SESSION is fully compatible with all leading software like Lotus, WordStar, WordPerfect, dBase IV, SideKick, Norton Utilities, etc. Imagine the time savings you'll enjoy working on your office PC — from your home! You can print documents, transfer files — even work together with an associate or customer — remotely!

Printing Features.

Printer output can be directed to the host and remote machine — simultaneously. The remote user may spool the output for later printing.

Voice/Data Switching.

Toggle back and forth between voice and data (using just ONE phone line) or, start with a voice call, load CO/SESSION during the conversation, then switch to a CO/SESSION data connection. It also offers a COM port window — handy when setting up a non-Hayes modem. A "chat window" allows users to send and receive messages on-screen.

Smooth, Fast File Transfers and Error-Checking.

Copy data files in both directions — so you can work at home — without transporting diskettes!

CO/SESSION's powerful error-checking capabilities allow you to call your office PC and copy an entire APPLICATION FILE to your home computer.

Advanced Security.

CO/SESSION protects your data with features like: dual-passwords, password-checking and data encryption. You can restrict the ability to send or receive files on the remote PC, blank the other computer's screen — even disable its keyboard to prevent unauthorized access. So if you're doing support on a remote PC, you can work in complete privacy — users or passers-by will not be able to see what you're doing. And CO/SESSION includes a



"dial-back" feature that provides an additional level of security and reverses phone charges (for long-distance sessions) and unmatched error-checking for data safety.

Fastest Remote Software Available.

CO/SESSION transfers files up to 20% faster — updates screens up to 400% faster than competitors! In fact, CO/SESSION was proclaimed "Fastest Remote Software Package" by *InfoWorld* in March, 1989!

Never worry about leaving disks at the office, working there late or coming in on weekends. Do it all remotely, any hour of the day, any day of the week. Share updated information instantly between offices, troubleshoot computer problems remotely, download files, train personnel and more.

Take advantage of your office computing power while on the road. It's like traveling with full office support in your laptop.

NOW AVAILABLE! Session/XL

Automate File Transfers, Printing and Running of Programs on Remote PCs.

Session/XL is a remarkable new scripting language that actually allows you to automate communications and, working in conjunction with CoSession, can help you manage, support and maintain remote PCs from a central location. You can transfer files, print reports remotely or locally, execute programs and DOS commands and much more — 24 hours a day, seven days a week — with speed, power and ease.

Deliver new applications and solutions! Session/XL is ideal for companies that need to collect or send data to many remote locations or offices spread across many time zones. Tasks can be scheduled by elapsed time, and run unattended during evening hours when phone rates are lowest and PC usage is minimal.

Powerful Error Checking. Session/XL contains state of the art error handling and screen checking capabilities. When errors are detected, they can be automatically recorded and signal Session/XL to continue with the next system for remote activity. Screen checking allows Session/XL to check a specific line or a range of lines for a character string.

The ability for Session/XL and CoSession to work together minimizes software expenses while maximizing communication capabilities. Together these two products provide remote access, file transfers, printing, automated communications and customer support solutions.

- Powerful scripting language
- Fully automatic operation
- High speed file transfers
- Remote execution of programs
- Remote printing
- Error control
- Activity results log
- Screen checking
- Data compression
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Co/Session LAN

The Only Remote Access Software for Network Communication Servers!

Introducing the only remote access software package for network communication servers. CO/SESSION LAN gives you the power to use any PC on the network for remote access, file transfers, customer support, terminal emulation and automated communications.

From any computer dial in or out via any modem on your communication server. Share phone lines and modems without sacrificing capabilities. CO/SESSION LAN provides a complete communication solution in one network communication package.

CO/SESSION LAN supports most asynchronous communication servers including those manufactured by Novell, Network Products, J & L Information Systems, Cross, Banyan, Gateway and Concept Development Systems.

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LW 3840 CO/SESSION LAN	 \$495.00
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And FastPak Mail has been designed to quickly import names and addresses from most popular database applications, like dBASE, so you can easily customize letters and envelopes without rekeying information.

FastPak Mail is an ideal tool for direct mail campaigns—it's fast, feature-rich, and can easily handle up to 64,000 names and addresses. In fact, this remarkable package actually contains many features found in high-end systems written expressly for direct marketers.

FastPak Mail is so advanced, you can give it a zip code, and it will automatically look up the city, state and area code — then insert it directly into your list, or print a label or envelope.

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Experts agree that one of the most cost-effective methods of promoting your business is to prepare and mail a newsletter to your existing customers (or to a list of prospective customers) on a consistent basis. News relating to your particular industry, questions and answers, new product announcements and "how-to" articles can boost customer awareness and help increase sales. Newsletters keep your name in front of your customers without appearing to be junk mail. Using FastPak Mail, you can reduce the time you spend mailing your newsletters, and mail them more often—that's the key, consistent, professional mailings.

Timely Press Releases.

FastPak Mail is also a great tool for use in mailing press releases. Because they usually contain time-sensitive information, press releases must be mailed immediately. FastPak Mail gives you the power to get the job done—now.

Ready To Print Lists And Labels.

FastPak Mail will support virtually any label made — by any manufacturer. Choose from pre-defined formats available from the menu, or quickly create your own format to fit your particular needs.

Print labels 1, 2, 3 and 4 across in dozens of sizes and shapes. FastPak Mail supports all popular continuous feed label brands.

Print all of this and more... labels (any configuration), return address labels, envelopes, rotary index cards, clear adhesive labels, file folder labels, diskette labels, audio and video cassette labels, shipping labels, equipment ID labels, packing labels and dozens more. Just select the type you need from the list of built-in formats and go!

Merge Information — In Minutes.

FastPak Mail will allow you to easily merge names and addresses into the body of any letter. You

can quickly produce custom mailings to selected lists — even merge information into the body of your letter.

And if you have existing lists stored in other applications, they can be quickly and accurately converted for use in FastPak Mail.

Automatic Proper Name Capitalization.

FastPak Mail will print the first letter of proper names in capital letters — automatically — regardless of how they appear in the list or database file — eliminates embarrassing errors in your mailings.

Bulk Mail Sorting, Printing And Preparation.

FastPak Mail simplifies bulk mail by streamlining the entire process. All bulk mail regulations and associated labels are available from the menu, and all sorting is done to achieve the least possible cost — like 9, 5, and 3 digit zip code sorting.

FastPak Mail even produces sack labels — all you have to do is drop it off at the post office!

Addresses Express Shipping, Airbills, UPS C.O.D. Labels.

You can use FastPak Mail to finish up mailing chores by addressing Federal Express airbills, U.S. Post Office Express Mail airbills — even UPS C.O.D. labels. The pre-designed templates for these forms



are available from the menu and will support virtually any printer.

FastPak Mail will also print shipping labels using a pre-defined format — or create your own.

Laser Printing Capabilities.

FastPak Mail supports all Hewlett-Packard compatible laser printers. Now everything you mail can be crisp and authoritative, taking full advantage of laser technology's broad range of fonts, sizes and formats. FastPak Mail will support all printer fonts as well as downloaded fonts — even print sideways!

And FastPak Mail includes an innovative print spooling feature that rivals many stand-alone packages.

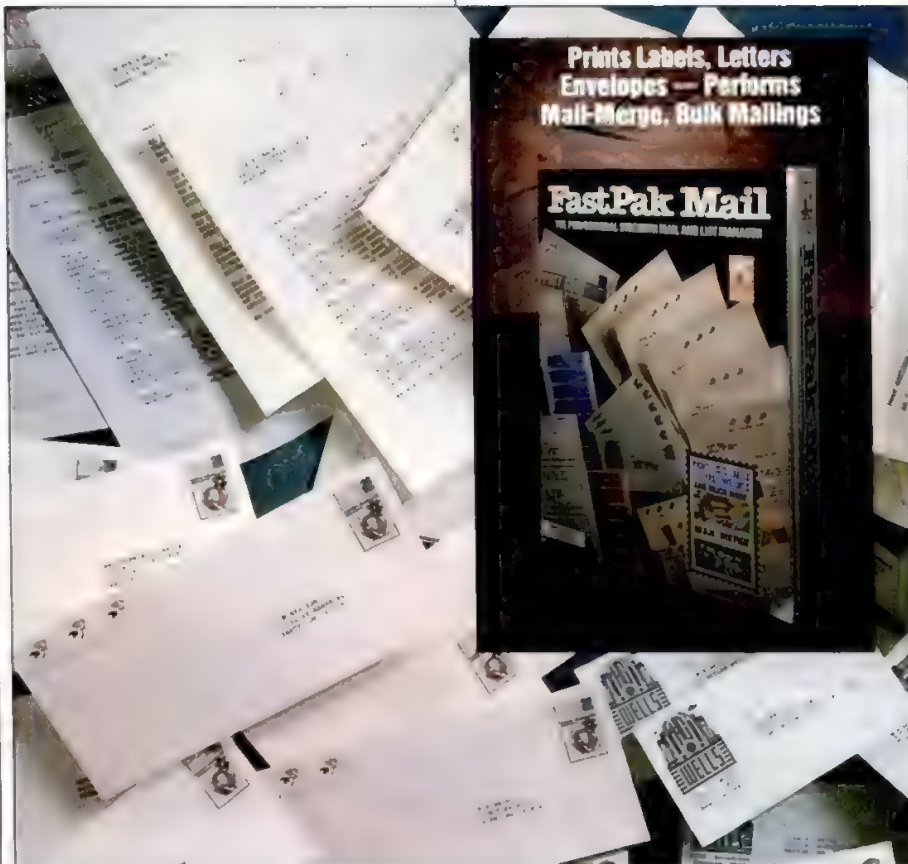
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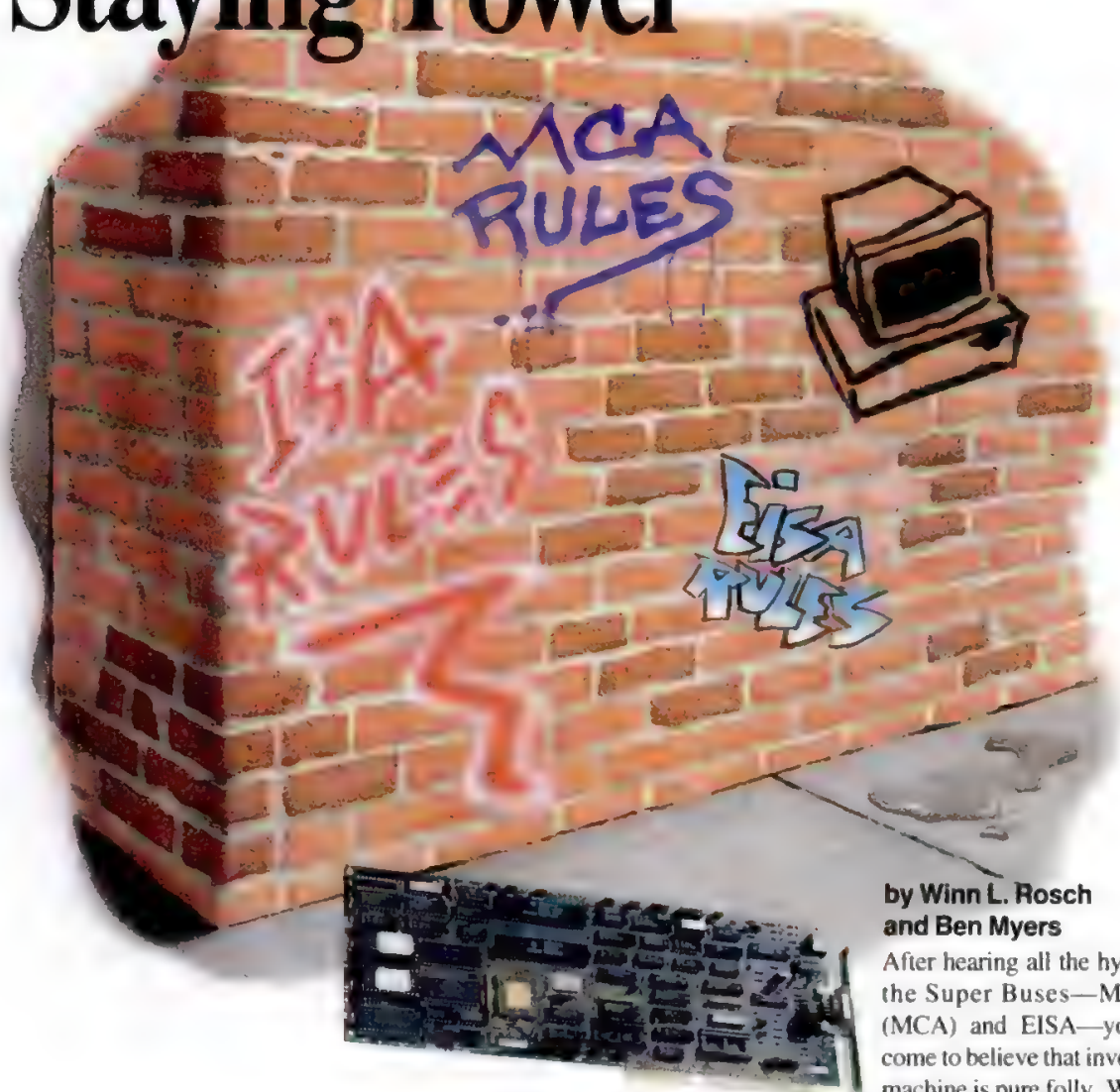
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THE BUS WARS:

ISA's Surprising Staying Power

ILLUSTRATION: KEITH LOBUE PHOTOGRAPHY: RICK BECKER



by Winn L. Rosch
and Ben Myers

After hearing all the hype surrounding the Super Buses—Micro Channel (MCA) and EISA—you've probably come to believe that investing in an ISA machine is pure folly. Well, we're here to tell you that if you're a single user,

upgrading today from your friendly ISA machine to a 32-bit bus architecture is simply a waste of valuable resources. No, we're not kidding.

And we're not just saying that the extra performance isn't worth the extra money. Through rigorous testing at two *PC Magazine* locations—PC Labs in New York and PC LAN Labs in Florida—we found that in a single-user DOS environment, and in network setups with up to a dozen workstations, no significant performance premium exists. When you consider the relatively small number of add-in boards for EISA and MCA, these architectures seem even less appealing. For now, and for some time to come, ISA is still your best bet.

PC Labs tests three battling bus designs and finds an unexpected winner in ISA. You may pay more for EISA and MCA, they won't give you better performance in a single-user DOS environment.

As for medium-to-large local area networks, EISA and MCA do have the capability to add speed and functionality. But MCA's limited industry support and EISA's market immaturity are yet more deterrents to investing in them.

You may find these conclusions heretical or even illogical. Read on to see why we feel so strongly.

THE THREE CONTESTANTS

The contenders for your choice of expansion bus are, of course, the classic AT bus lately known as Industry Standard Architecture (ISA), Enhanced Industry Standard Architecture (EISA), and Micro Channel architecture (MCA).

The first two trace their heritage back to the expansion bus of the original PC, the cobbled-together computer creation that was expected to sell barely 100,000 copies to die-hard electronics hobbyists and IBM employees. Its unexpected success ushered in the personal computer revolution—and the need to flood the market with machines actually designed to be business computers. That effort first brought forth the AT with its improved, 16-bit expansion bus and ability to address 16 megabytes of memory (compared with the 8-bit bus and 1MB limit of the original PC). The expansion bus these machines used is now universally acknowledged as the industry standard (except, of course, by those with their own fish to fry and apples to bake).

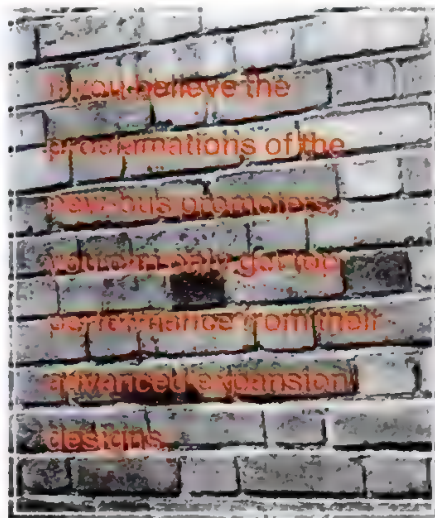
Shortly after the AT was introduced and microprocessors moved into higher-megahertz territory, the major shortcoming of the AT bus became apparent. It was too slow to keep up with the memory needs of 80286 microprocessors running faster than 8 MHz. Pushing the AT bus faster wouldn't work; companies like Dell Computer Corp. tried and discovered that most expansion boards failed at 10 MHz or higher.

Compaq Computer Corp. showed the world a better way with its Flex Architecture, which separated microprocessor memory from the general expansion bus. Through a direct route to the microprocessor, memory could operate at speeds as fast as available chips would allow. All current high-performance PCs now use a variation on this theme, packing megabytes of direct access memory on the system board and often adding proprietary slots for memory expansion.

This technique worked and still does.

Even IBM now infuses its system boards with 8 or more megabytes of fast RAM. But today's 80386 and 80486 microprocessors hint at performance problems to come. The 16-bit data path and 24-bit addressing of the AT bus cannot take advantage of the full potential of these newer chips, which prefer a 32-bit data path and 32-bit addressing.

IBM's answer to the problems of the AT bus was the Micro Channel architecture, which brought a busload of disadvantages along with its greater data-moving capacity and other innovations. A total



break with the past, the Micro Channel was (and is) incompatible with PC and AT expansion boards. MCA may be technically advanced, but it makes designing expansion boards and compatible computers aggravatingly difficult. And being laced with proprietary IBM technology, it bears a hefty price because of the royalty that machine manufacturers must pay IBM to use the company's patented handiwork.

EISA was developed by the "Gang of Nine," a consortium of leading IBM-compatible PC makers led by Compaq Computer Corp., and was designed to offer the power of the Micro Channel without its disadvantages. EISA's forward-thinking features essentially duplicate those of the Micro Channel—a setup program, bus arbitration, shared interrupts—without the penalties. After all, the EISA architects could look to the Micro Channel for guidance as to what they could incorporate into their design. They benefited both from hindsight and from the admonition followed by all leading reverse engineers and burglars: steal only the best.

While they were running the Micro Channel's specifications through the Xerox machine, the EISA architects also choreographed a new dance, the patent-office sidestep. As a result of their fancy footwork, no royalties are required for using EISA technology (although other elements of EISA computers may require licensing and royalty payment).

For board designers, the best aspect of EISA is its backward compatibility. Expansion boards for the EISA bus don't have to be any more complex than traditional ISA boards. Although advanced EISA board designs are about equal in complexity to their Micro Channel counterparts, ordinary PC board designs still work for ordinary purposes. Engineers can get simple interface boards to market without a struggle.

THE PROMISE VS. REALITY

If you've been listening to the deprecations the two competing advanced-bus lobbies have been lobbing at one another, you've probably come to believe that the best reason for moving ahead to a new bus design is performance speed. IBM insisted that the Micro Channel can run circles around ISA. When EISA was introduced, the Gang claimed greater speed than IBM had provided. In answer, IBM infused even more speed into the Micro Channel (think of the new design as "Son of Micro Channel" or "Micro Channel II: IBM's Revenge").

According to the wild claims, these newfangled architectures could blast the text of a business plan or a complete novel from board to board in a fraction of a second. An ordinary spreadsheet could flash through the system faster than a leap of faith. If you believe the proclamations of the new-bus promoters, you can only get top performance from your next computer using one of their advanced expansion designs.

Unfortunately, specifications and reality coincide about as often as all the major planets conjoin. While numbers don't lie, often they don't reflect reality or your own expectations. The big numbers touted by manufacturers for expansion bus performance may not be relevant in everyday use of a computer. In fact, they may turn out to be theoretical constructs that will never be visible in the harsh light of the office—paper specs that are of no value when you need to get your work done and done quickly.

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HOW TO TELL THEM APART: THE BUS CONNECTORS

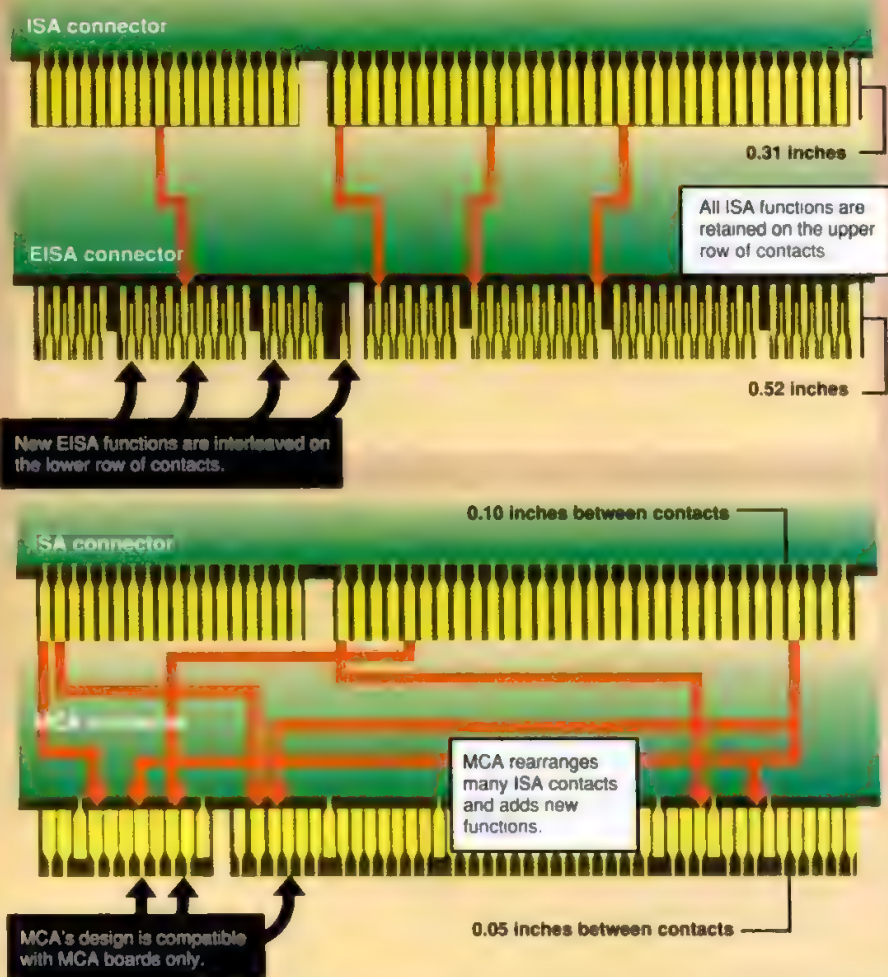
The telling difference among the three major bus options in the PC environment is the edge connector on each card.

The EISA connector was designed for full backward compatibility with ISA boards. All the connections of the ISA bus are present in their ordinary positions, but a new, lower row of contacts is added to link up the advanced functions of the bus. The developers linked these new contacts to the expansion board circuitry by interleaving their connecting traces between the ISA contacts on the card.

Micro Channel, on the other hand, forgoes hardware compatibility and guarantees only software compatibility with classic AT-bus computers. Thus, the MCA designers were free to alter the ISA layout completely, rearranging the functions of the contacts to minimize interference and to promote higher-speed operation. They added new functions as well.

The result is that Micro Channel boards work only in Micro Channel slots. EISA slots will accommodate both ISA and EISA expansion boards, but this is a one-way compatibility: EISA boards cannot be used in ISA expansion slots.

—Winn L. Rosch



WHAT LIES BEHIND THE NUMBERS

PC Labs set out to find the truth. Are the performance claims warranted? What do they mean to you as a user? And which bus is really faster?

To answer those questions, PC Labs developed new benchmark tests for evaluating bus performance, then ran them on two groups of machines chosen to highlight the differences among the buses. At one end were our *control group*, which were "uncooked" factory-stock base machines, identical except for their bus architectures; we stripped out all other differences. At the other extreme, we selected machines from the top configurations of the major vendors in each of the three bus categories, which we "cooked" by loading them with the fastest, cost-is-no-object

performance-enhancing options available. We refer to these as our *enhanced machines*. These "cooked" computers were meant to probe the limits of the currently available technology.

For the factory-stock machines, PC Labs chose the ALR PowerCache 4 (MCA) and ALR PowerCache 4e (EISA), both from Advanced Logic Research. These twin towers are identical in micro-processor architecture and price (\$14,989), and they use exactly the same cache, related circuitry, and cabinetry. We replaced the 4e's Hitachi hard disk with the Maxtor hard disk from the PowerCache 4 to eliminate even slight differences in configuration. We also operated the 4e in a degraded mode as an ISA computer to complete the three-bus comparison.

At the high end, the classic-bus choice was an Everex StepServer/Storage Dimen-

sions FileMaster—a 33-MHz 386-based networked file server (\$13,999)—which we also reconfigured and retested as a single-user system. In this form it was equivalent to the Everex Step 386/33 (\$10,697) with an added Diamond SpeedSTAR VGA video controller (\$590).

The Micro Channel standard-bearer was a \$7,252 IBM 20-MHz 386-based PS/2 Model 80 enhanced with a Core International bus-mastering hard disk controller (model CNT-MCA, \$495) and 650MB hard disk (\$3,295). For our LAN server tests (Network Throughput Under Load), we upgraded the unit from 2MB to 8MB RAM. (IBM's new 25-MHz Model 80-A31 became available too late to be included in these tests.)

The EISA performance engine was Compaq's top-of-the-line Systempro, a 33-MHz dual-386 network-server monster

with its performance-optimizing disk array. We tested this machine with its Intelligent Drive Array (IDA) for the LAN tests, and we replaced the IDA with a Compaq external 650MB ESDI hard disk for the DOS tests. (The Systempro is not designed as a DOS machine; the IDA lacks a DOS driver, and thus the overhead the IDA creates impairs system performance in DOS tests.)

We conducted our tests to represent today's prevailing PC environments: single-user PCs running DOS and network servers dishing up Novell's *NetWare*. What this testing revealed was often unexpected. For example, we found no need to factor out the differing microprocessor performance among the systems. The bus (or what was connected to the bus) proved to be the governing factor, and once microprocessor performance passed a minimum level—approximately that delivered by a 16-MHz 386—results converged to a definite limit. In other words, the tests zeroed in on the shortcomings of bus performance, and the results were disconcerting.

THE PERFORMANCE PUNCH LINE

And the winner is . . . For speed alone, the bus race was a dead heat. And for real-world value, ISA proved the best bet for single-user DOS applications.

Information moved across each bus at about the same rate. With today's applications, your choice of bus makes virtually no performance difference, whether your PC is a world unto itself on your desk or a server handing off files to a dozen other PCs. Forget the claims and hype. The old classic AT bus still has a lot of life in it, enough that you'll not suffer for having it inside your next PC.

We found that larger LANs are another story, with possibly a different winner. In this type of bus-crunching application, a sophisticated bus design can really make a difference. In this capacity, MCA is slightly ahead of EISA, but each has its drawbacks in terms of industry support. Compared with ISA, a limited number of companies make boards for MCA machines, which may or may not influence your buying decision. As for EISA, the market is so young that boards that work at all are currently few, but the next year should see an influx of boards that support the Gang of Nine's venture. A well-designed bus can't improve performance without a selection of additional hardware that takes advantage of it.

TESTING STRATEGY

These conclusions were as hard to reach as they are to swallow. Although it sounds like sacrilege to recommend tired old ISA, this conclusion was borne out by some of the most extensive benchmark testing PC Labs has ever performed.



Our primary goal was to evaluate the effects of different expansion buses on actual computing chores. Instead of simply measuring bus operating speeds (just attaching a frequency counter will achieve that), PC Labs measured actual throughput—how much data an application can move through the bus in a specified period of time. Throughput, rather than theory, determines how much actual work your computer can do. The new benchmark tests were created to measure the throughput of each major element of a PC system: the microprocessor, the display system, the mass storage system, and the network interface.

The performance of the microprocessor and its associated memory were measured by PC Labs' Dryshell Processor test. (Although this test doesn't measure bus performance, its results help us to sort out the results of other tests.) This measure is based on Reinhold Weicker's Dhrystone test, originally published in the *Communications of the ACM* (October 1984), but modified so that the test code would not execute solely from cache memory.

The name Dhrystone is actually derived from another performance measure, the Whetstone test. The wet/dry pun contrasts the different aspects of performance measured by the tests. The Whetstone test investigates scientific and engineering processing capacity by evaluating mathematical performance. The Dhrystone mea-

sure looks at tasks more relevant to desktop computing: integer arithmetic, character-string handling, and function calls. Even seemingly mathematically oriented PC applications such as *Lotus 1-2-3* rely almost entirely on integer arithmetic rather than floating-point operations.

Because the traditional Dhrystone test runs in a relatively tight loop, it shows few performance differences between systems that have the same microprocessors and clock speed but that use disparate caching technologies and sizes. The tiny test simply runs entirely within the cache at the top speed of the microprocessor. PC Labs' Dryshell Processor test compensates for the small computational kernel by duplicating itself four times and dividing up the work among four copies of its algorithm.

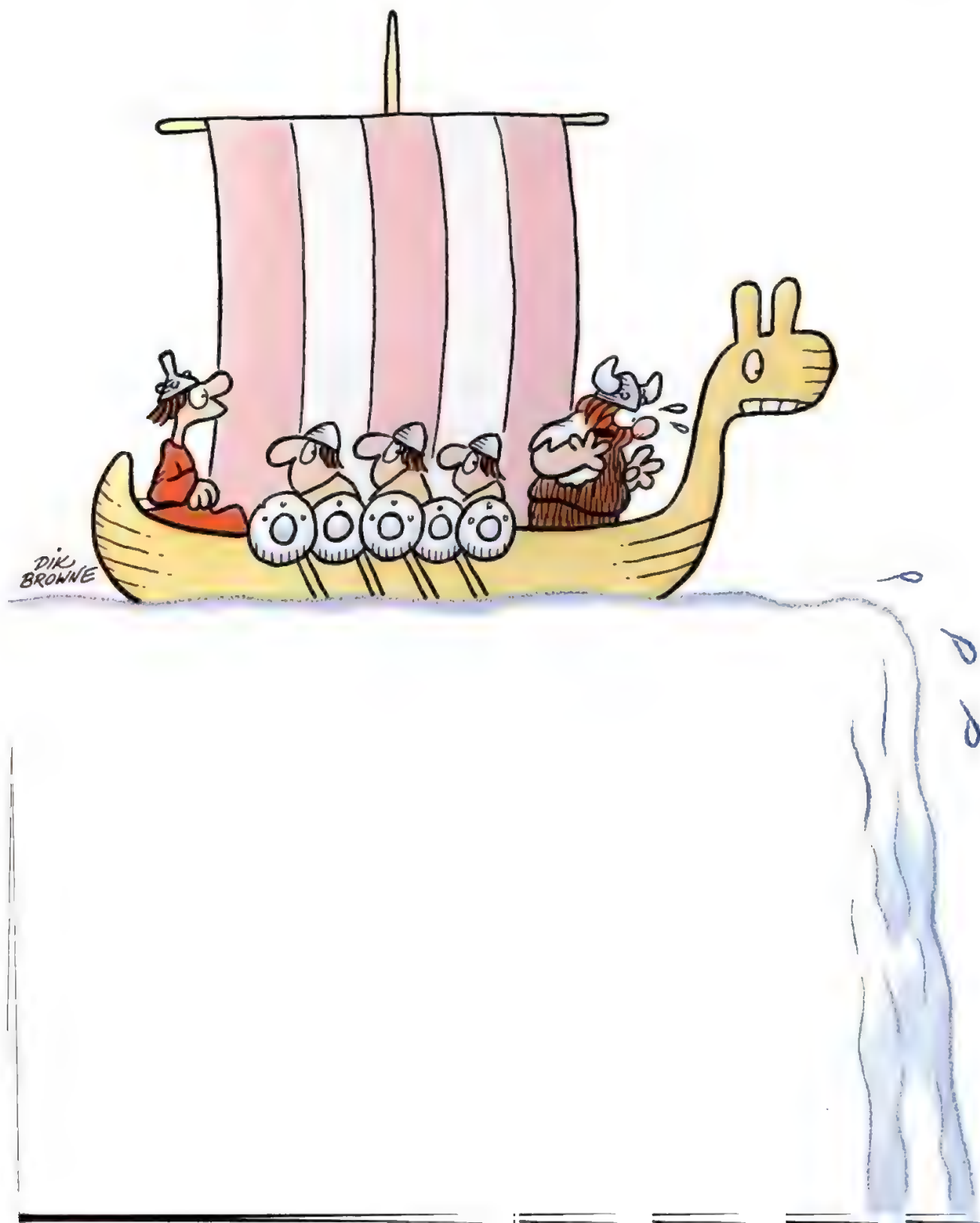
The Dryshell Processor test reflects the capabilities of the latest software for high-performance computers, in that it was written using simulated 32-bit mathematical instructions. The test was compiled using Microsoft C, Version 5.1.

To isolate the video system—specifically, VGA circuitry—from the rest of each computer undergoing evaluation, PC Labs developed a new measure of display speed called the VGA Controller Throughput test. This performance test measures the display system's maximum throughput in kilobits per second by repeatedly filling the screen with horizontal lines, rotating among 16 different colors.

The VGA Controller Throughput test stressed the display system well beyond the demand of any actual application. While the display speed of ordinary application software is limited by the microprocessor time required to generate screen images, the VGA performance test has no such overhead. Consequently, it is essentially independent of the system's microprocessor. For example, when we tried running the VGA test using the same video card in an 8-MHz 286 and in a 33-MHz 386, the results matched within 2 percent. The VGA test does not measure text processing speed, because the time to refresh a full character-based screen is minuscule compared with that required in drawing graphics images.

To separate mass storage performance from the rest of each system, PC Labs developed the Disk Controller Throughput test. This performance test reads and writes a sequential file in blocks of a predefined size. Sequential operations using a large block size (32K in this evaluation) minimize the mechanical limitations on

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hard disk performance—latency and seek times—and maximize the amount of data flowing from the disk into the host computer system. This allows the hard disk subsystem to push data across the expansion bus as fast as it possibly can. This is a true test of bus throughput as you would see it in actual use.

We also tested Disk Controller Operations per Second using a small block size (512 bytes) to measure the performance of the hard disk controller by maximizing the number of operations the controller needed to carry out. In effect, this test measures controller overhead as well as throughput. Using still smaller block sizes makes no sense, because the low-level format of PC hard disks does not permit reading or writing less than a single 512-byte sector at a time. Reading or writing blocks smaller than 512 bytes primarily measures DOS and microprocessor rather than disk performance.



To measure the maximum possible throughput of network data, PC Labs installed a network adapter card in each tested system, which then received data sent across the LAN in large blocks by three Compaq Deskpro 386/25s (with 3Com Etherlink II cards). The data transfers occurred as fast as Ethernet could carry them without packet collisions.

The sending and receiving programs established the NetBIOS sessions to carry out this exchange of data using the *NetWare 2.15 IPX* (Internet Protocol Exchange). Note that in evaluating test results the efficiency of the NetBIOS driver is as important to network throughput as the LAN card's hardware design.

We had no trouble running our Network Throughput Under Load tests, in which each tested system is configured as a server. But for the Network Adapter Throughput test, where the tested systems are set up as nodes rather than servers, we ran into problems when trying to test the EISA bus. We could find only one EISA

Ethernet board on the market designed for nodes, and it could not complete our tests.

For our Network Throughput Under Load tests at PC LAN Labs, we set up each of the systems using *NetWare 386*, Version 3.0, and connected it to networks of zero, three, six, and ten constantly active nodes. (One exception was the Everex StepServer/Storage Dimensions Filemaster, which warranted testing under *NetWare 286*, Version 2.15, because the ROM in the high-performance hard disk controller was not yet compatible with *NetWare 386*.) The network carried out its transactions in block sizes of 512 bytes, 4K, and 16K, and we converted the transfer times into kilobit-per-second throughput figures.

PCs OF CHOICE

All of the PCs that were involved in these bus tests represent the state of the art in design technology. They use the latest, highest-performance microprocessors available—either 20- or 33-MHz 386 chips or 25-MHz 486s. The machines were equipped with 2MB to 12MB of high-speed RAM connected to sockets on the system board or dedicated memory expansion boards rather than the normal system expansion bus.

None of these machines stoop to using an ordinary ST-506 hard disk; all opt for at least one ESDI disk. The Systempro uses a tightly knit array of drives to optimize mass storage performance (we used a solo 650MB ESDI drive, however, when evaluating the Systempro as a single-user system). As the tests demonstrate, any of these machines would be an excellent anchor to hold a network faced by the most awesome gales of workstation demands. For single-user situations, some of these machines are actually overkill; the Systempro's full features don't come into play until it starts serving networks.

The ALR PowerCaches 4 and 4e are the PC equivalents of the World Trade Center—matched towers that are head and shoulders above all but a few competitors. Each machine is based on a 25-MHz 486 (the fastest version of the chip available at test time) coupled with a proprietary cache design that features a 128-bit-wide data path and a full 128K of 25-nanosecond static RAM cache.

These two machines have identical hardware. Each tower measures 23.5 by



FACT FILE

ALR PowerCache 4

Advanced Logic Research Inc., 9401 Jeronimo, Irvine, CA 92718; (714) 581-6770.
List Price: With 25-MHz 80486, 8MB RAM, 330MB hard disk, 1.44MB 3.5-inch floppy disk drive, one serial and one parallel port, VGA color monitor, \$14,989.

CIRCLE 409 ON READER SERVICE CARD

ALR PowerCache 4e

List Price: With 25-MHz 80486, 8MB RAM, 330MB hard disk, 1.2MB 5.25-inch floppy disk drive, two serial and one parallel port, VGA color monitor, \$14,989.

CIRCLE 410 ON READER SERVICE CARD

7.5 by 18.5 inches (HWD), and each offers the same drive capacity. Four half-height drives fit into bays at the top front of the case. A single internal full-height bay swings out on a clever, hinged panel. Each of the half-height devices mounts to an individually removable shelf. The internal hard disk screws to the swing-out panel through six shock mounts.

When fully assembled, the ALR tower cases are fairly sturdy, although like most tower cases, they pale in comparison with the solidity of the Systempro. For example, the ALR half-height bays are weakly mounted on one side. Although these towers are structurally better than the company's past efforts, they still lack the quality we have a right to expect in a \$15,000 computer.

The operating accoutrements of the two ALR systems are nearly identical as well. The main switch for the 220-watt 115/230-volt power supply is at the rear edge of the top of the case. Tiny power and drive activity LEDs are hidden at the top of the system's black sculptured front panel. Connectors for the standard input/output ports sprout from the center of the rear panel and include serial, parallel, mouse, and keyboard connectors (one of each). Both systems come with VGA.

While the EISA machine uses a standard 5-pin DIN connector for the keyboard, the Micro Channel machine uses a miniature DIN connector exactly like that of IBM's PS/2 series. The MCA tower comes with a 1.44MB 3.5-inch floppy disk drive; the EISA machine is equipped with a 1.2MB 5.25-inch drive.

The primary difference between the twins is the system board that lines the right side of the case. The Micro Channel machine uses a 14.5- by 11.5-inch board

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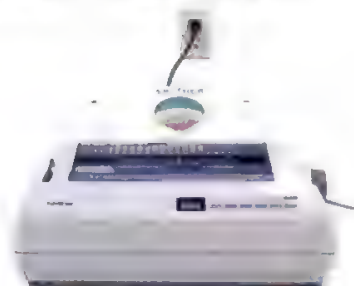
Epson LQ 850



IBM ProPrinter X24E



Okidata Microline 390



Brother M-1824L

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HOURS	1000	2000	3000	4000	5000	6000
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Okidata Microline 390	[Bar extending to approximately 4500 hours]					
Epson LQ 850	[Bar extending to approximately 4000 hours]					
IBM ProPrinter X24E	N/A					

* MTBF specifications from: Okidata 1989 bulletin MS8489-789; Epson 1988 bulletin CPD883-3/89-2R-75 000-1700-005

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SUMMARY OF FEATURES: EISA VS. ISA VS. MCA

To configure these computers for testing, PC Labs added hard disks and high-performance disk and video controllers from various vendors. In some cases, the tested configurations are not commercially available. See the fact files for pricing information.

Expansion bus type This review includes machines constructed around all three bus types: EISA, ISA, and MCA. Although the PowerCache 4e is an EISA machine, we also ran tests on a PowerCache 4e reconfigured as an ISA machine.

Case type indicates whether each computer has a small-footprint, desktop, or tower design.

386 chip set manufacturer indicates which company made the support logic that connects the CPU with the functions managed by the system board. Chip sets that use VLSI (very large-scale integration) technology reduce the discrete component count, which in turn helps to reduce power consumption and increase component life.

The **system RAM arrangement** is the method in which memory is addressed. Remember that CPU speed is usually faster than conventional memory speed.

Interleaved memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

Page-mode memory allows back-to-back memory accesses within blocks of memory called pages without wait states.

Row/column is the traditional method of accessing data at a memory address, with the RAM being mapped as a matrix and a particular address being given using a row and a column number.

Wait states On the average, most machines run between zero and one wait state. The figures printed here were supplied by the respective manufacturers.

RAM packaging (and rated speed) Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs.

The *dual in-line package (DIP)* is the traditional buglike computer chip sprouting 8, 14, 24, 40, or more metal legs (evenly divided between right and left sides).

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection.

Single in-line memory modules (SIMMs) are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates easy installation and replacement.

Chip size Kb and Mb refer to kilobits and megabits, respectively.

Processor RAM cache A processor RAM cache acts as a bridge between the CPU and the slower main memory. The cache comprises a small bundle (typically 32K to 128K) of fast SRAM chips. The cache controller is designed to predict and retrieve the data the CPU is likely to require next, thus preventing wait states. There are two varieties of controllers: discrete logic chips (designed by the individual manufacturers) and VLSI chips like the Intel 82385.

The **BIOS version and date** can affect PC Labs' benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Setup can reside either on a floppy disk or in ROM.

Shadowing Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed at the cost of 384K of memory from the first 1MB of system RAM. The ability to disable shadowing is important with some applications to resolve memory conflicts.

Hard disk manufacturer Within the 386 PC environment, the three most common hard disk interfaces are *ST-506*, *SCSI (small computer system interface)*, and *ESDI (enhanced small device interface)*.

Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers. The *IDA (Intelligent Drive Array)*, an EISA peripheral exclusively from Compaq, can control up to eight hard disks, treating them as one logical drive.

Bus speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 MHz. Note that the Micro Channel and ESDI buses operate at variable speeds, up to about 14.5 MHz.

The **display circuitry location** can be either on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled it prevents upgrades.

Interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

FCC certification class Two classes of FCC (Federal Communications Commission) approval, Class A and Class B, may be given to computers. Class A approval signifies that a computer has sufficiently low radio-frequency emissions for operation in a business locale. The more stringent Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

COVER STORY

BUS WARS

Products listed in alphabetical order

	Advanced Logic Research Inc. ALR Power Cache 4	Advanced Logic Research Inc. ALR Power Cache 4e	Compaq Computer Corp. Compaq Systempro	Everex Systems Inc. Everex Step 386/33	Storage Dimensions Inc. Everex StepServer/Storage Dimensions FileMaster	IBM Corp. IBM PS/2 Model 80-111
Expansion bus type	MCA	EISA (also configured as ISA)	EISA	ISA	ISA	MCA
TESTED CONFIGURATION						
Microprocessor	25-MHz 80486	25-MHz 80486	Two 33-MHz 80386s	33-MHz 80386	33-MHz 80386	20-MHz 80386
Case type	Tower	Tower	Tower	Desktop	Desktop	Tower
Dimensions (HWD, in inches)	23 x 7.5 x 18.5	23 x 7.5 x 18.5	23.5 x 7.5 x 22	6.5 x 21 x 16	6.5 x 21.2 x 16.5	23.5 x 6.5 x 19
Motherboard manufacturer	ALR	ALR	Compaq	Everex	Everex	IBM
386 chip set manufacturer	Intel	Intel	Compaq, Intel	Everex	Everex	IBM, multisource
System RAM arrangement	Interleaved, page-mode, row/column	Interleaved, page-mode, row/column	Page-mode	Row/column	Row/column	Page-mode
Wait states	0	0	0	0	0	0-2
MOTHERBOARD MEMORY						
Installed RAM	None	8MB	None	8MB	8MB	2MB (A), 4MB (B)
RAM packaging (and rated speed)	N/A	SIMM (100 ns.)	N/A	SIMM (100 ns.)	SIMM (100 ns.)	Proprietary memory modules (85 ns.)
Chip size	N/A	256Kb, 1Mb, 4Mb	N/A	1Mb	1Mb	1Mb
ADD-IN MEMORY BOARD						
Installed RAM	8MB	None	12MB	None	None	None (A), 4MB (B)
RAM packaging (and rated speed)	SIMM (100 ns.)	N/A	DIP (80 ns.)	N/A	N/A	DIP (85 ns.) (B)
Chip size	256Kb, 1Mb, 4Mb	N/A	1Mb	N/A	N/A	1Mb (B)
PROCESSOR RAM CACHE						
Cache controller manufacturer	ALR	ALR	Intel	Everex	Everex	N/A
Installed RAM	128K	128K	2 x 64K	128K	128K	N/A
RAM packaging (and rated speed)	DIP (25 ns.)	DIP (25 ns.)	SRAM (25 ns.)	SIMM (25 ns.)	SIMM (20 ns.)	N/A
Chip size	64Kb	4 x 16Kb	4 x 32 Kb	64Kb	64Kb	N/A
BIOS						
BIOS version and date	Phoenix 1.01.02 (December 1989)	Phoenix 0.10.02 (February 1990)	Compaq 386E (December 1989)	AMI F3-38 (1989)	AMI F3-38 (1989)	F801 (1987)
Setup in ROM	☐	■	■	■	■	☐
Password in ROM	■	☐	■	☐	☐	☐
Video shadowing/Can be disabled	■/■	■/■	■/☐	☐/☐	☐/☐	☐/☐
System shadowing/Can be disabled	■/■	■/■	■/☐	■/■	■/■	■/☐
HARD DISK						
Manufacturer	Maxtor	Maxtor	Compaq (A), Conner (B)	Seagate/Wren	Maxtor	Core
Disk capacity	330MB	330MB	650MB (A), 840MB (B)	330MB	2 x 155MB	650MB
Interface	ESDI	ESDI	ESDI (A), IDA (B)	ESDI	SCSI	ESDI
Controller location	Motherboard	Card	Card	Card	Card	Card
Controller manufacturer	Western Digital	Adaptec	Compaq	DTC	Storage Dimensions	Core
Integrated floppy/hard disk controller	■	■	☐	■	■	■
Drive bays	1 full-height, 4 half-height, 1 3.5-inch	1 full-height, 4 half-height, 1 3.5-inch	10 half-height, 1 one-third-height	5 half-height	2 full-height, 5 half-height, 5 3.5-inch	4 full-height

■—Yes ☐—No

N/A—Not applicable: the product does not have this feature.

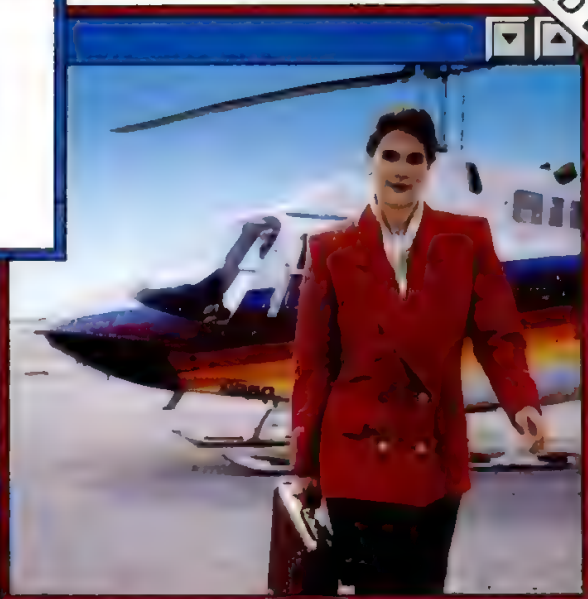
(A)—This pertains to our DOS single-user tests and also to our Network Adapter Throughput test, where the computer was configured as a node on a network.

(B)—This pertains to our Network Throughput Under Load tests, where the computer was configured as a network server.

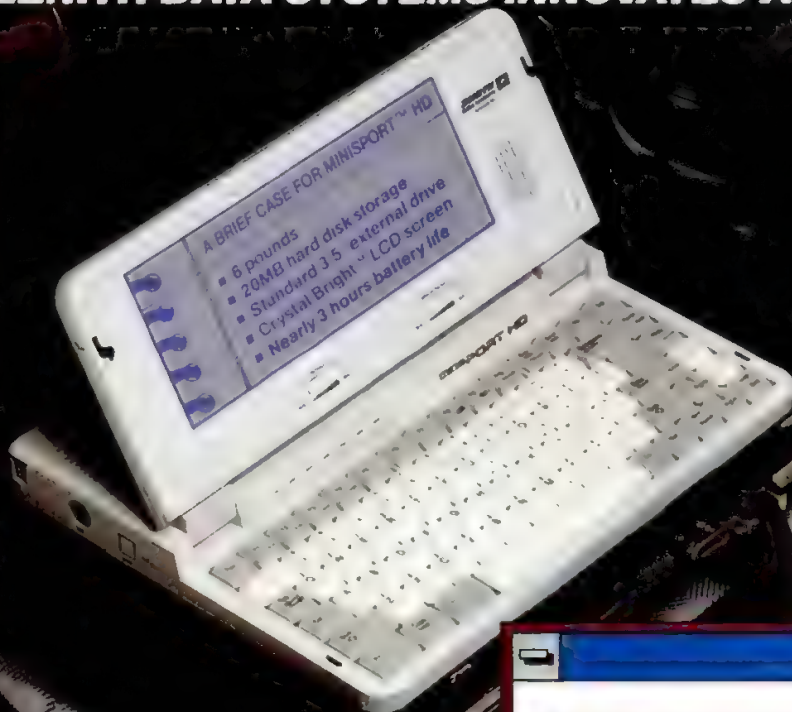
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CIRCLE 732 ON READER SERVICE CARD

*Source: Dataquest—True portable PC sales.

Graphics simulate Microsoft® Windows 3.0, a product of Microsoft Corporation.

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SUMMARY OF FEATURES: EISA VS. ISA VS. MCA

Products listed in alphabetical order

	Advanced Logic Research Inc. ALR Power Cache 4	Advanced Logic Research Inc. ALR Power Cache 4e	Compaq Computer Corp. Compaq Systempro	Everex Systems Inc. Everex Step 386/33	Storage Dimensions Inc. Everex StepServer/ Storage Dimensions FileMaster	IBM Corp. IBM PS/2 Model 90-111
FLOPPY DISK DRIVES						
Type	1.44MB	1.2MB	1.44MB, 1.2MB	1.2MB	1.2MB	2 x 1.44MB
Manufacturer	TEAC	Fujitsu	Citizen, Canon	TEAC	TEAC	IBM
EXPANSION BUS	MCA	EISA (also configured as ISA)	EISA	ISA	ISA	MCA
Bus speeds (MHz)	Variable	8	8	11.1	16.5	5
Expansion slots	Four 16-bit, two 32-bit, one proprietary	One 8-bit, one 16-bit, six 32-bit, one proprietary	Seven 32-bit EISA, four proprietary	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Four 16-bit, three 32-bit
Slots left free after hard and floppy disk drives, video, one parallel and two serial ports are installed	4	6	8	6	6	6
Ports originate on motherboard	■	■	■	□	□	■
VIDEO						
Display circuitry location	Card	Card	Motherboard	Card	Card	Card
Interface	16-bit VGA	16-bit VGA	16-bit VGA	16-bit VGA	8-bit monochrome	8-bit VGA
Manufacturer	ALR	ALR	Compaq	Diamond	Everex	IBM
Chip set manufacturer	Chips and Technologies	Tseng Laboratories	Compaq	Tseng Laboratories	Everex	IBM
NETWORK CONFIGURATIONS						
PC Labs configuration (A):						
Adapter	3Com Etherlink/MC	EISA: N/A; ISA: 3Com Etherlink II	N/A	3Com Etherlink II	N/A	3Com Etherlink/MC
Operating system	NetWare 286, Version 2.15	NetWare 286, Version 2.15	N/A	NetWare 286, Version 2.15	N/A	NetWare 286, Version 2.15
PC LAN Labs configuration (B):						
Adapter	Novell NE232	EISA: Novell NE3200; ISA: Artisoft NE2000	Novell NE3200	N/A	3Com 3C505	Novell NE232
Operating system	NetWare 386	NetWare 386	NetWare 386	N/A	NetWare 286, Version 2.15	NetWare 386
MISCELLANEOUS						
Coprocessor installed	N/A	N/A	80387-33, Weitek 3167-33	None	None	None
Power supply (watts)	200	300	300	200	200	225
FCC certification class	A	A	B	A	A	B

■—Yes □—No

N/A—Not applicable: the product does not have this feature.

(A)—This pertains to our DOS single-user tests and also to our Network Adapter Throughput test, where the computer was configured as a node on a network.

(B)—This pertains to our Network Throughput Under Load tests, where the computer was configured as a network server.

ENDS

with a single proprietary daughtercard for memory. This board bears sockets for 16 SIMMs (single in-line memory modules). The system board holds six Micro Channel expansion slots, two with full 32-bit connectors and four with 16-bit; two of the latter slots have the MCA video extension.

The PowerCache 4e EISA machine requires a larger system board measuring 14.5 by 14 inches, overlaid with a second 12- by 7-inch board that chiefly holds memory—a total of 32 SIMM sockets. Of its eight slots, six use 32-bit EISA connec-

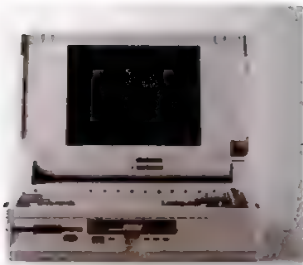
tors, one is 16-bit, and one is 8-bit. Both systems use Intel VLSI chips, a Phoenix BIOS, and a Dallas clock/CMOS module.

The exact match of these systems' architectures allowed PC Labs to control all factors in system design, the only variable being the bus. In fact, during evaluation the same hard disk was alternately used in both systems to eliminate any differences arising from variations in disk performance.

Visually, EISA and MCA diverge most markedly in the size of their motherboards.

The EISA motherboard is larger not because it is more complex than its MCA counterpart, but because the expansion board is larger—as is the slot—and requires a larger plane inside the machine. These differences have no effect on price, with one exception. The smaller MCA system board fits in a desktop package, which lowers the cost of the ALR base system with monitor from \$11,989 to \$10,489 (with a 120MB hard disk in lieu of the 150MB model that comes standard in the tower).

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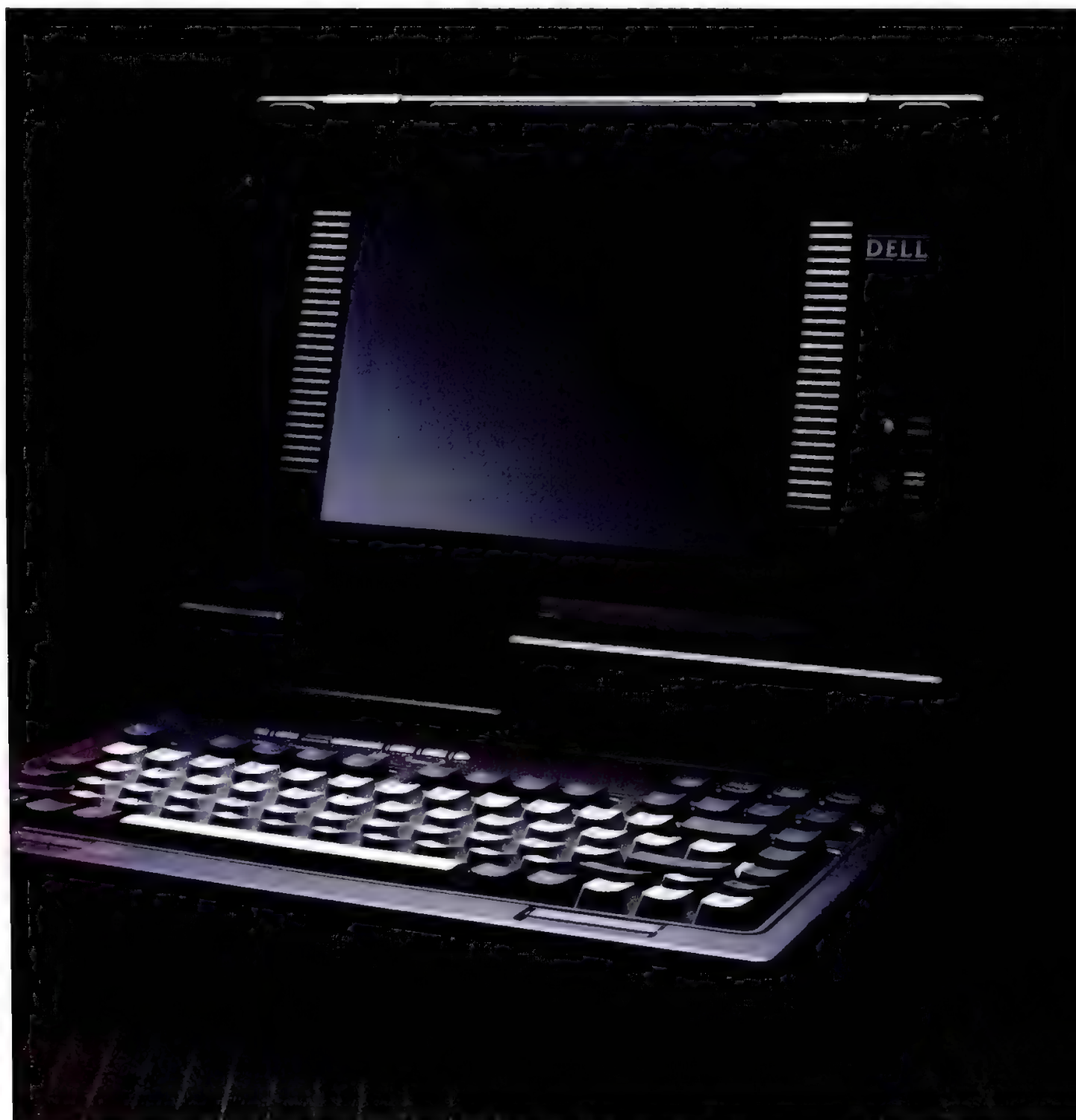
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CIRCLE 527 ON READER SERVICE CARD

COVER STORY BUS WARS

COOKED ISA

In the "cooked" category, the most mundane and least costly choice is the Everex Step 386/33. The company's basic configuration, with no hard disk, 2MB of RAM, and a 64K cache, costs \$6,299. The extra 6MB RAM, 330MB hard disk, quadruple cache, and Diamond SpeedSTAR VGA controller drive the price up to \$11,287.

Almost prototypical of the ISA school, the Step 386/33 looks like an ordinary AT clone: its 6.5- by 21- by 16-inch case has an AT layout (three half-height bays on the right, all with front-panel access, and a full-height internal bay). Inside, the 12- by 14-inch system board looks conventional enough with its pin-in-hole components, even the familiar Tadiran battery Velcroed to the side of the 200-watt power supply for maintaining the CMOS setup memory. Most of the chips are PLAs (programmable logic arrays, standard chips that create custom circuit configurations), making up for the dearth of VLSI on the board. Memory is confined to the space behind the hard disk, where eight SIMM sockets are available. The 8MB system board capacity can

be doubled with a proprietary high-speed memory expansion board.

The standard eight expansion slots are installed, six with 16-bit interfaces, two with 8-bit. In the evaluation system, three were filled by a VGA adapter, a hard disk controller, and an input/output adapter with two serial and one parallel port.

The indicator panel that hides behind a sliding smoked plastic door in the front panel distinguishes the Step 386/33. In addition to the expected keyboard lock and power and disk activity indicators, it also includes an alphanumeric display and three LEDs to indicate speed.



guished by its scalable memory cache, the component that makes the machine really cook. The Step 386/33 runs at a higher-than-average bus speed of 11.1 MHz but will automatically switch to 8.5 MHz if any incompatibilities arise. For testing, we used an optional Diamond VGA adapter (which will be released by the time this issue hits the newsstands); it proved the fastest graphics board that PC Labs has yet encountered—twice as fast as Compaq's integrated system board circuitry.

COOKED MCA

Our souped-up Micro Channel machine is IBM's veteran 20-MHz PS/2 Model 80 enhanced with a 16-bit bus-mastering Core 15-MHz ESDI hard disk controller and matching hard disk. Little changed from the original 16-MHz Model 80, the 20-MHz machine is built inside the same stalwart plastic tower that also serves as the foundation for the much-maligned Model 60. The 23.5- by 6- by 19-inch case accommodates two 3.5-inch floppy disk drives on slide-in front-panel sleds and two full-height 5.25-inch drives in a subchassis frame (one with front-panel access).

The 11- by 15.5-inch system board is

cleanly laid out in mostly surface-mount components and IBM ASICs (application-specific integrated circuits) that incorporate VGA, serial and parallel port, and floppy disk control circuitry. The eight expansion slots provide three 32-bit and five



FACT FILE

IBM PS/2 Model 80-111

IBM Corp.; contact your local authorized IBM dealer; (800) IBM-2468.

List Price: With 20-MHz 80386, 2MB RAM, 115MB hard disk, two 1.44MB 3.5-inch floppy disk drives, one serial and one parallel port, VGA color monitor, \$7,252.

Tested With: Core International Inc.; CNT-MCA bus-mastering hard disk controller, \$495; 650MB hard disk, \$3,295.

CIRCLE 414 ON READER SERVICE CARD

16-bit connections, one of the latter having a video-extension connector.

COOKED EISA

Any way you look at it, the Compaq Systempro is an awesome machine, including its \$41,143 tested-configuration price (the base price is \$15,999). The intent behind its design is obvious: the Systempro is the ultimate PC. It is designed as a network server, and many of its advanced features (such as its drive array) won't come into play in single-user operation. No DOS driver is available for the drive array, so we conducted the single-user performance tests with a Compaq-supplied external high-performance hard disk.

That said, the Systempro looks as if it benefits from the craftsmanship of out-of-work builders of tanks and battleships who were displaced by the peace raging in Europe. Few mountains are as solid. The 23.5- by 7.5- by 22-inch aluminum chassis has its own unique design, with an angled set of bays for three removable-media drives at the top and a hidden nest for eight hard disks inside the bottom. A 300-watt power supply fills the top of the case.

The Systempro's floppy disk drives are one-third-height devices (the 3.5-inch and the 5.25-inch drive in the evaluation system both used high-density disks). Only the first slot is actually one-third-height; the second bay is half-height, with a thin panel filling the gap between disk drive and bay. A DC-600-style streaming tape backup unit also graced the front panel.

The eight internal drive bays are not remarkable, but the drives' electrical link-up is. Multiple hard disks inside the System-



FACT FILE

Everex Step 386/33

Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; (415) 498-1111.

List Price: With 33-MHz 80386, 8MB RAM, 330MB hard disk, 1.2MB 5.25-inch floppy disk drive, two serial and two parallel ports, VGA color monitor (without video controller), \$10,697.

Tested With: Diamond Computer Systems Inc.; SpeedSTAR VGA video controller with 1MB RAM, \$590.

CIRCLE 412 ON READER SERVICE CARD



FACT FILE

Everex StepServer/Storage Dimensions FileMaster

Storage Dimensions Inc., 2145 Hamilton Ave., San Jose, CA 95125; (408) 879-0300.

List Price: With 33-MHz 80386, 8MB RAM, two 155MB hard disks, 1.2MB 5.25-inch floppy disk drive, two serial and two parallel ports, monochrome monitor, \$13,999.

CIRCLE 413 ON READER SERVICE CARD

be doubled with a proprietary high-speed memory expansion board.

The standard eight expansion slots are installed, six with 16-bit interfaces, two with 8-bit. In the evaluation system, three were filled by a VGA adapter, a hard disk

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A lot of companies offer low priced modems. There's only one problem. They're not Everex.

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lation, testing and verification a breeze. They also come with the most comprehensive manuals in the industry. And our line covers everything from internals to fax modems.

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Chances are, you'll get more modem than you need. For less money than you'd expect.



pro can be synchronized to function as a single, large hard disk array using Compaq's Intelligent Drive Array Controller. The largest array currently available uses four disks to yield 840MB.



FACT FILE

Compaq Systempro

Compaq Computer Corp., P.O. Box 692000,
20555 SH 249, Houston, TX 77269-2000; (713)
370-0670.

List Price: With two 33-MHz 80386s, 12MB
RAM, 840MB hard disk, 150/250MB tape drive,
1.44MB 3.5-inch and 1.2MB 5.25-inch floppy disk
drives, two serial and one parallel port, VGA color
monitor, 80387-33 coprocessor, Weitek 3167-33
coprocessor, \$41,143. Also tested with ESDI
650MB hard disk, \$9,399.

CIRCLE 411 ON READER SERVICE CARD

The system board inside measures 11 by 15.5 inches. Microprocessors—the Systempro can use one or two—reside on proprietary processor boards. The evaluation system includes two 33-MHz 386 processor boards, one equipped with matching-speed Intel 387 and Weitek 3167 coprocessors. Both CPU boards also bear Intel 82385 cache controllers and 64K static RAM caches. A proprietary memory board comes with two memory modules, each containing 2MB RAM. An additional dual-socket proprietary memory module containing 1-megabit (1Mb) chips holds an additional 8MB, yielding a total of 12MB RAM.

I/O ports (two serial, one parallel), a floppy disk drive controller, and fast VGA circuitry are built into the system board. Besides four proprietary slots (three of which are filled, two with CPU boards and one with memory), seven full 32-bit EISA slots are located on the system board.

SURPRISING RESULTS

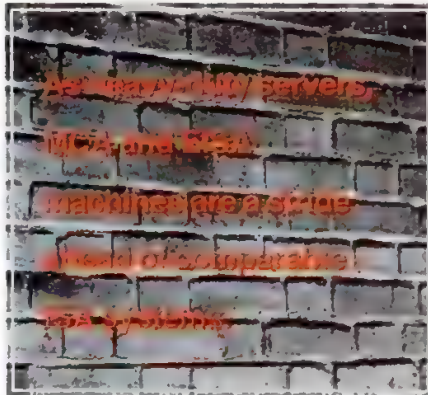
The single-user tests of these six systems confirmed past evaluations and expectations as far as microprocessor and video performance are concerned. The 486 microprocessor proved its mettle in the ALR machines, using its burst mode to blast ahead of 386 processors running at faster clock speeds. Certain expansion boards shone, like the lightning-quick Diamond VGA adapter in the Everex machine—twice as fast as even the tightly integrated 16-bit VGA circuitry of the Systempro—while a vintage 8-bit VGA connection shackled the Model 80 like a ball and chain. In fact, we found the Dia-

mond VGA was nearly 13 times as fast as the Model 80's video card.

As testing became increasingly bus-dependent, however, the differences between the test machines evaporated. Put identical high-speed hard disks in machines with the same microprocessors and cache architectures and the bus doesn't matter, as our three ALR machines demonstrate: with a few exceptions, the test results are nearly indistinguishable.

The bottom line for people using DOS applications is: put your money in good video controllers, put your money in plenty of RAM, but don't spend more than the price of a good ISA machine to get a performance bonus from MCA or EISA.

Yet that's not the end of the story. Run NetWare on one of the evaluation systems



and link it to a number of nodes and you begin to see the differences between architectures. To pursue this idea, PC LAN Labs ran benchmark tests on each of the six reviewed machines. The EISA and MCA servers used appropriate Novell 32-bit adapters, and the ISA servers used a 3Com 3C505 16-bit adapter. The suite that provided the load for the servers included four 25-/33-MHz 386 PCs, two 20-MHz 386s, and five Dell System 200s with 12-MHz 286 CPUs.

The results show that as servers, the MCA and EISA machines are a stride ahead of comparable ISA systems, with MCA edging out EISA—given the network adapters and driver software used. We should emphasize that a single tweak, like rewriting the driver software of a LAN adapter, could alter the EISA/MCA performance relationship. But the general advantage of these bus architectures over ISA in a heavy-duty server is logical and is supported by the test scores.

These results also show that with to-

BENCHMARK TESTS:
EISA VS. ISA VS. MCAThe Challenge of Testing:
EISA vs. ISA vs. MCA

Our bus architecture tests had two parts: we configured three control-group machines—identical except for their buses—to isolate and measure bus performance, and we configured "enhanced" machines to push each bus to its limits. We performed all of our tests on both sets of machines.

The control-group systems consisted of Advanced Logic Research's ALR PowerCache 4 (MCA) and 4e (EISA), two 25-MHz 486s with identical architectures. By downgrading the 4e, we were able to test it as an ISA machine as well. Each of these machines was equipped with 8MB RAM, a 330MB (formatted) ESDI hard disk from Maxtor, and a VGA color monitor.

For an enhanced MCA system, we used the 20-MHz IBM PS/2 Model 80-111 with 2MB or 8MB RAM, plus Core 650MB hard disk and controller, and VGA color monitor. Our enhanced EISA system was the Compaq Systempro with two 33-MHz 386 processors, 12MB RAM, VGA color monitor, and two coprocessors, along with an external 650MB ESDI hard disk (for DOS single-user tests) or an Intelligent Drive Array and 840MB hard disk (for Network Throughput Under Load server tests).

As for ISA, we ran the DOS single-user tests on the Everex Step 386/33 with 8MB RAM, 330MB ESDI hard disk, Diamond SpeedSTAR VGA video controller (which is slated to ship by the time this issue goes to press), and VGA color monitor. For the Network Throughput Under Load tests we used the Everex StepServer/Storage Dimensions FileMaster with a 33-MHz 80386, 8MB RAM, two 155MB SCSI LANstore hard disks, 128K cache, and monochrome monitor.

For LAN tests, we chose the following network boards: For the Network Adapter Throughput test, we equipped the ALR PowerCache 4 and IBM Model 80 with the 3Com Etherlink/MC. The ISA-configured ALR PowerCache 4e and the Everex Step 386/33 used the 3Com Etherlink II; the other ALR PowerCache 4e and the Compaq Systempro had no network board installed, since no available EISA Ethernet boards could complete our tests.

Three Compaq Deskpro 386/25s, with 3Com Etherlink II network boards, were connected to an Ethernet hub, which was then connected to each test machine. The test ran under the NetWare 2.15 IPX (Internet Protocol Exchange) and NetBIOS.

For the Network Throughput Under Load server tests, the ALR PowerCache 4 and the IBM Model 80 used the Novell NE232; the ISA-configured ALR PowerCache 4e used the Artisoft NE2000, while the Everex StepServer/Storage Dimensions FileMaster used the 3Com 3C505. The ALR PowerCache 4e and the Compaq Systempro used the Novell NE3200. We ran all these server tests using NetWare 386 except when testing the Everex StepServer/Storage Dimensions FileMaster; this we tested under NetWare 286, Version 2.15, because the ROM in the high-performance hard disk controller was not yet compatible with NetWare 386.

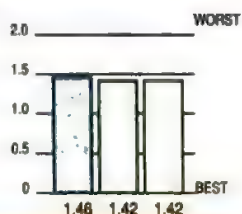
Our standard suite of benchmark tests revealed few performance differences attributable solely to differences in bus architecture. Nonetheless, in this ALR family of machines, the ISA- and EISA-based platforms performed identically—and outperformed the MCA machine on the majority of tests.

PROCESSOR AND MEMORY BENCHMARK TESTS

80386 Instruction Mix

Elapsed Time (seconds)

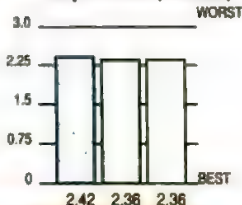
The 80386 Instruction Mix benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



Floating-Point Calculation Without Coprocessor

The Floating-Point Calculation Without Coprocessor benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

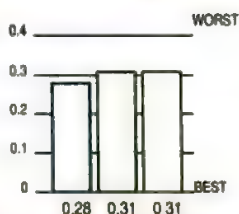
Elapsed Time (seconds)



Conventional Memory

Elapsed Time (seconds)

The Conventional Memory benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

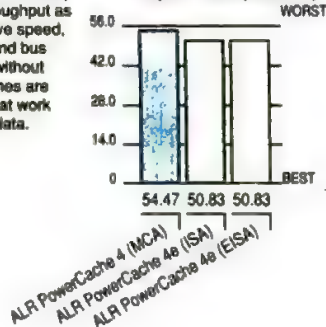


DISK BENCHMARK TESTS

DOS File Access (Small Records)

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

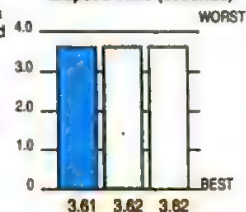
Elapsed Time (seconds)



DOS File Access (Large Records)

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

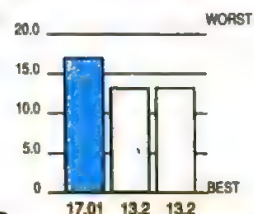
Elapsed Time (seconds)



BIOS Disk Seek

Elapsed Time (milliseconds)

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

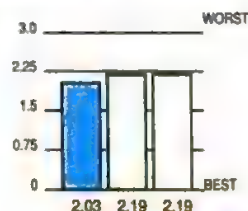


VIDEO BENCHMARK TESTS

Direct to Screen

Elapsed Time (seconds)

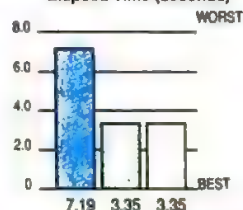
The Direct to Screen benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



Video BIOS Routine Without Scrolling

The Video BIOS Routine Without Scrolling benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

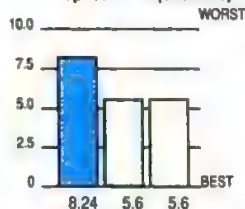
Elapsed Time (seconds)



Video BIOS Routine with Scrolling

The Video BIOS Routine with Scrolling benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

Elapsed Time (seconds)



CONTINUES

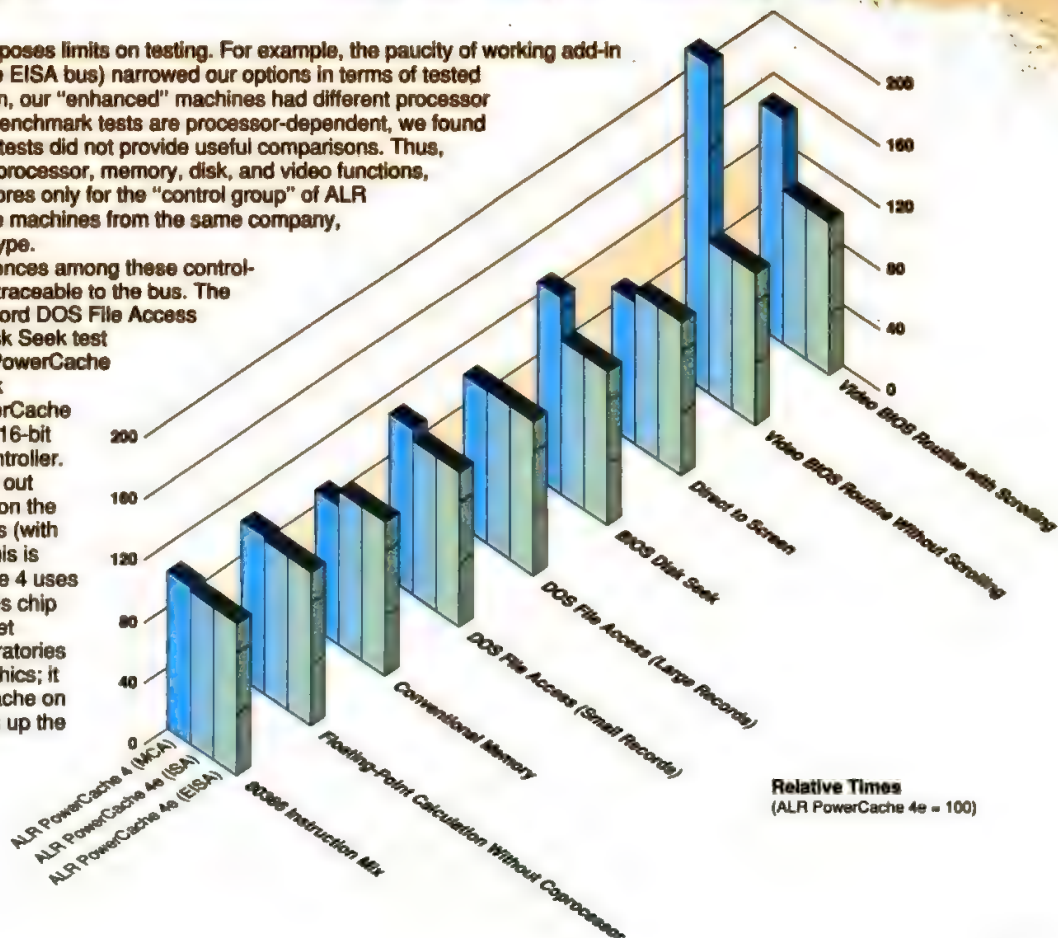


BENCHMARK TESTS: COMPOSITE VIEW

New technology often imposes limits on testing. For example, the paucity of working add-in boards (especially for the EISA bus) narrowed our options in terms of tested configurations. In addition, our "enhanced" machines had different processor speeds; as most of our benchmark tests are processor-dependent, we found that the results on those tests did not provide useful comparisons. Thus, on our standard tests of processor, memory, disk, and video functions, we are publishing the scores only for the "control group" of ALR PowerCache PCs—three machines from the same company, identical except for bus type.

Even so, some differences among these control-group machines are not traceable to the bus. The results for the Small-Record DOS File Access test and for the BIOS Disk Seek test differ because the ALR PowerCache 4 uses a DMA 16-bit disk controller while the PowerCache 4e uses a more efficient 16-bit programmed I/O disk controller.

The machines turned out markedly different times on the Video BIOS Routine tests (with and without scrolling). This is because the PowerCache 4 uses a Chips and Technologies chip set, while the 4e's chip set comes from Tseng Laboratories and is optimized for graphics; it has a small amount of cache on the chip, and this speeds up the video function.



ENDS

day's level of CPU performance, the hard disk array remains the biggest bottleneck. The next most significant limitations are imposed by the LAN adapter and data bus; CPU power falls after all of these in the rank order of subsystems that influence server throughput. In the future, you'll run more applications on server CPUs and this order of importance will change, but today you would be wise to spend your server money buying disk, bus, and LAN adapter throughput.

UNFULFILLED PROMISES

Reconciling these results and the bus promoters' lavish promises of improved performance requires careful analysis of the technology, the claims, and today's applications.

The theoretical underpinnings of the

claims are solid. Both EISA and MCA claim to move bytes faster than could ever be possible in classic-bus computers. The



claims make sense for a number of reasons. First, both buses potentially double the width of the expansion channel, from the classic bus's 16 bits to the full 32-bit capacity of today's latest microprocessors,

the Intel 386 and 486. In addition, they alter the timing of the signals on the bus and the protocols used for transferring data across the bus.

The maximum speed at which classic-bus computers can transfer data between expansion boards is 16 megabits (16Mb) per second. Each transfer requires two cycles of the bus clock; the 16-bit bus can move two bytes in this period, and the typical maximum bus clock speed is 10 MHz. (Some machines offer higher speeds, but they may suffer compatibility problems with some expansion boards.) The standard 8-MHz speed of the classic AT bus yields a slightly lower 64Mb per second maximum transfer rate.

EISA preserves the 8-MHz bus speed of the classic AT bus. (Because the EISA bus is generally operated synchronously with the system microprocessor, its actual

Other laser
printers
play with
one standard
dot size.

HP makes it a

ASTRONOMY IS LOOKING UP

THE HIRSCH REPORT OF THE SKIES VOL. 8 NO. 4 FALL 1990

STAR SHORTS

Reported by The Star

Every day billions of dust particles enter into Earth's atmosphere. Now scientists are working to make me-

teor-burst communication a practical and economical alternative to the use of tele-

(continued on page 2)

You Can't See the Great Wall from the Moon!

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to

an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects; the planet's swift mo-

(continued on page 3)

Voyager's Last Picture Show

When Voyager 2 was launched 12 years ago, who could have imagined these photos at this point in time.



More on planetary explosions inside.

NO BLACK HOLES?

Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

(continued on page 3)

MIRROR, MIRROR

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele-

(continued on page 3)

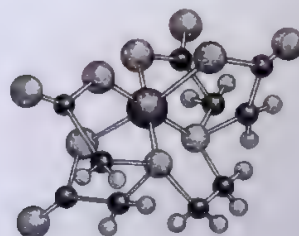
CHAIN REACTION

JACOBI'S CHEMICAL LETTER

JUNE 9, 1990

VOLUME FOUR

ISSUE THREE



New Loups in Metal-Organic Chemistry

Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A chelate, such as EDTA above (containing carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places. (continued next page)

What's New in Superconductivity?

It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct! (continued next page)

Antimatter Bottled

A device tested may give investigators a glimpse of what an antimatter world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time. (continued next page)

Fifty Years Ago

Rumor has it that before WWII, our chemists were experimenting with a distilling process to lower the calories of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shelf stable C ration. Don't believe all rumors.

1

Introducing the new HP LaserJet III printer with Resolution Enhancement technology.

The rules have changed. Now the name of the game is Resolution Enhancement technology. You'll call it the best thing to happen to laser printing since the very first HP LaserJet printer. It gives you clearer resolution. Curves that really curve. And edges that are never jagged.

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they could never go before. For clearer, more professional-looking documents.



Resolution Enhancement technology shrinks dots to fit in curves and diagonals where they've never gone before.

whole new ball game.



But there's more than better print quality. 14 bit-mapped fonts and 8 internal scalable typefaces provide thousands of options. And enhancements to our PCL5 printer language, including our HP-GL/2 graphics language, let you print portrait and landscape on the same page. Reverse and angled type. Spirals. Even shaded text. You can also plug in Adobe PostScript® software.

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reliability as the rest of the HP printer family.

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There is a better way.



**HEWLETT
PACKARD**

*Suggested U.S. list price. WordStar is a U.S. registered trademark of WordStar International Incorporated. Adobe and PostScript are registered trademarks of Adobe Systems, Inc.

CIRCLE 491 ON READER SERVICE CARD

speed is usually a submultiple of the microprocessor clock; thus, 25-MHz computers offer 8.33-MHz bus speeds and 33-MHz machines offer 8.25-MHz bus speeds. These fractional differences are negligible in terms of overall system performance.)

But EISA doubles the bus width, which immediately doubles the potential transfer rate (to 128Mb per second). It also includes an advanced operating mode that allows transfers to be made at a rate of one per cycle, achieving throughput rates as high as 256Mb to 264Mb per second (depending on the exact speed of the bus).

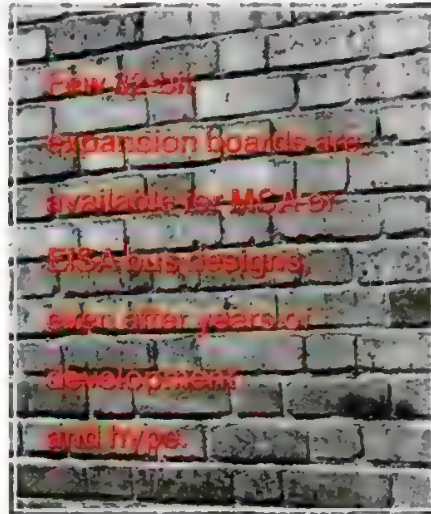
As originally conceived, the Micro Channel specification operated with 10-MHz bus cycles with a 32-bit data path and two cycles per transfer, achieving a 160Mb-per-second transfer rate. In the three years since its introduction, IBM has refined (read: changed) the MCA specification to add more transfer speed. Some 16-MHz (and potentially 33-MHz) machines can use a technique called matched memory mode, which reduces the bus cycle time by 37.5 percent and commensurately increases data transfer rate. Using a technique called streaming data mode, the Micro Channel cuts the overhead to achieve a rate of one cycle per transfer for the movement of sequential data. And by multiplexing the address bus during streaming data transfers (using the 32 address lines of the bus as data lines during the transfer), the Micro Channel offers what is essentially a 64-bit data path. Together, the one-transfer-per-cycle rate, effective 64-bit bus width, and 10-MHz cycle time yield a maximum possible throughput data rate of 80MB per second.

Look at real-world issues and the expansion products that are available today, and the claims disappear faster than spirits exposed to sunlight. For example, no available PC hardware can take advantage of the Micro Channel's streaming data modes, and only memory boards have been designed to use matched memory mode. Similarly, EISA's high-speed data transfer protocol has yet to see commercial application.

Bottom line: today the two buses have effectively the same data transfer rate, 20MB per second (assuming a 10-MHz cycle time in each case). This is, in fact, only a doubling of the transfer speed of the classic AT bus. Once you consider that precious few 32-bit expansion boards are available for either advanced bus design, one fact stands out: even today, after three

years of development and hype (in the case of the Micro Channel, at least), for practical purposes you'll win no raw performance advantage by using an advanced expansion bus.

As severe as the limits today's hardware impose on the expansion bus may seem, they pale in comparison to the inherent data throughput restrictions imposed by existing hardware standards. Because of these standards, even existing PC ex-



pansion boards do not push the classic AT bus to its limits. For example, the fastest PC expansion option you're likely to install is an ESDI hard disk.

The current top throughput rate for an ESDI drive is 20 megabits per second (at 20 MHz, the latest technology). Network adapters load the expansion bus even less. For example, the fastest an Ethernet adapter can possibly transfer data is 10Mb per second. Because of Ethernet's operating overhead (messages are sent as separate packets, with dead time between to allow multiple adapters to arbitrate for network time), a real-world network cannot attain even that speed except for short, packet-length bursts. The classic AT bus as it currently exists has more than five times the bandwidth required to sustain these worst-case loads. Clearly, the bus is not the performance limit with this hardware.

BOARD PLAY

The conclusions derived from these numbers are obviously contrary to the practical experience of anyone who has plugged boards into a high-performance computer. For example, an 8-bit hard disk controller

board is likely to turn in performance far worse than a 16-bit controller.

A number of factors contribute to the real-world performance difference you'll see when shifting from an 8-bit controller to a 16-bit controller. The biggest limit is imposed by the disk controller itself. If an expansion board cannot keep up with the rest of the computer system, it adds wait states to the system's operation. In fact, many system boards automatically add wait states to transfers from 8-bit expansion boards to insure that the system doesn't overwhelm the laggardly electronics of the expansion board. That's a key issue: expansion boards and not the expansion bus today create the most bothersome slowdowns in bus performance.

The Micro Channel attacks this problem head-on: you simply cannot use old, slow expansion boards in a Micro Channel computer. Instantly the speed limit imposed by old boards is broken. The penalty, of course, is that you cannot use older boards—even the quickest old boards—at all. But while you certainly won't want to plug a nine-year-old, performance-robbing serial card into a state-of-the-art 486-based PC, there are a lot of ISA expansion boards that you might want to use. Even after the three years that MCA has been on the market, the variety of boards available to fit classic-bus expansion slots is still many times greater than the number of options for MCA boards—and some rate as speed demons in their own right (for example, the ISA Diamond VGA adapter).

EISA gives you access to any old board you want to plug into your system—an option you won't want to exercise indiscriminately for performance reasons. But the capability is there.

NO ONE'S MASTER

Besides raw speed, the two new expansion bus designs also offer an advanced feature called bus mastering. The concept of bus mastering is elegant; it separates a computer's microprocessor from the expansion bus and in effect makes the chip work as if it were an expansion board itself. That puts the microprocessor and all the expansion slots on an equal footing and lets other microprocessors (or other devices, such as Direct Memory Access controllers) take direct control of the bus.

Having the microprocessor yield up control of the bus is much like having a corporate executive delegate authority to a department manager: the executive has

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G/Ethernet. Again and again, G/Ethernet has proven its performance by grabbing prestigious industry awards. We're happy about the high-performance that earned *PC Magazine's* Editors' Choice. But happier still are the tens of thousands of satisfied customers that use G/Ethernet every day.

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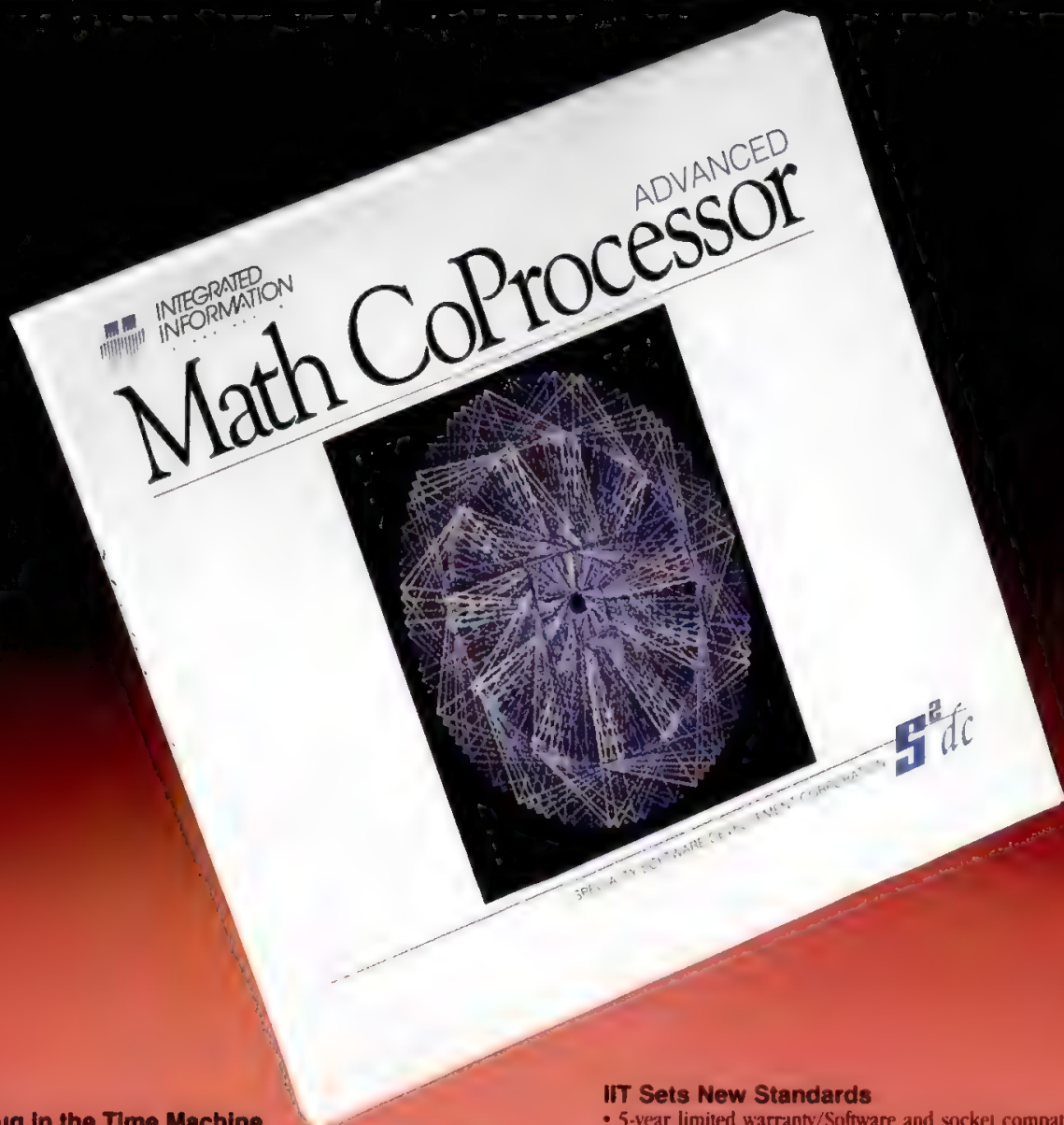
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communications, inc.

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CIRCLE 146 ON READER SERVICE CARD

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CIRCLE 346 ON READER SERVICE CARD



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Austin, TX 78746 • 512 327-8608



PERFORMANCE TESTS: EISA VS. ISA VS. MCA

For single DOS users there is no appreciable advantage to choosing a system other than ISA, especially when costs are factored in.

The **Dryshell Processor** test exercises integer arithmetic, character-string handling, and function calls, all of which are fundamental building blocks for commercial nonscientific applications. The program compensates for the small amount of code in the Dhrystone computational kernel by duplicating it four times and dividing the work among four copies of the Dhrystone algorithms. The test is written using 32-bit mathematical instructions to reflect the capabilities of the latest software for high-performance computers. A higher score indicates a better processor.

The **VGA Controller Throughput** test isolates the VGA Controller from the processor and measures its maximum throughput by repeatedly filling the screen with horizontal lines, rotating among 16 different colors. As with all of these throughput tests, higher scores indicate better performance.

The **Disk Controller Throughput Reading Large Blocks** test reads a sequential file containing 30 blocks, where each block is a 32K record. The test, which runs for 30 seconds, minimizes hard disk latency time, minimizes hard disk seek time, and maximizes the amount of data flowing between the disk controller and PC memory.

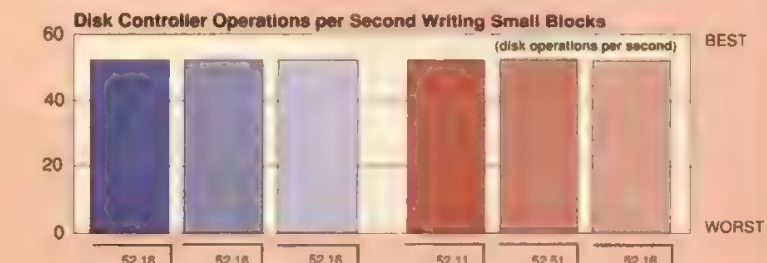
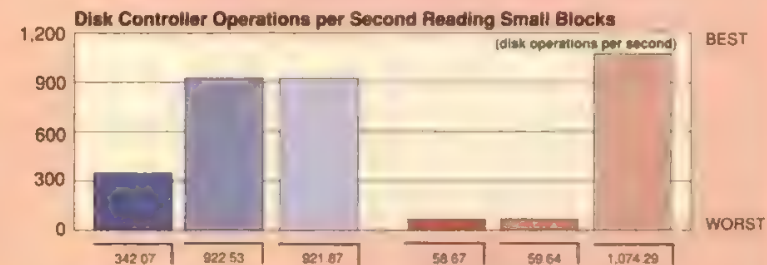
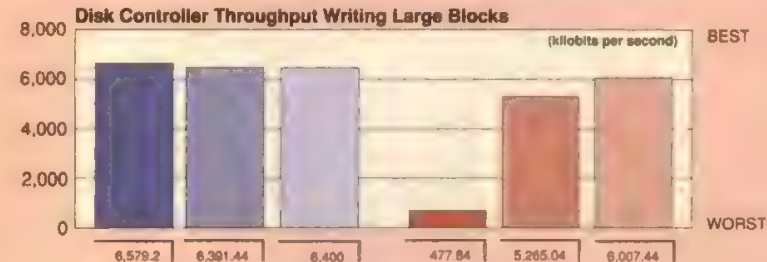
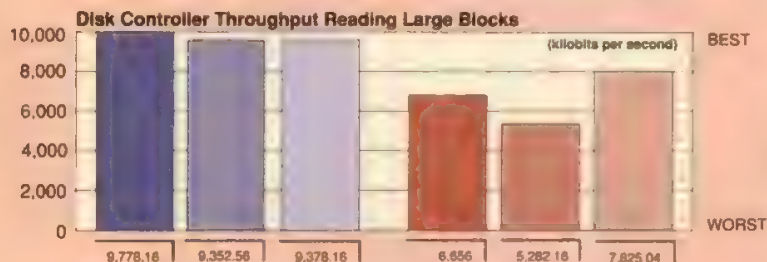
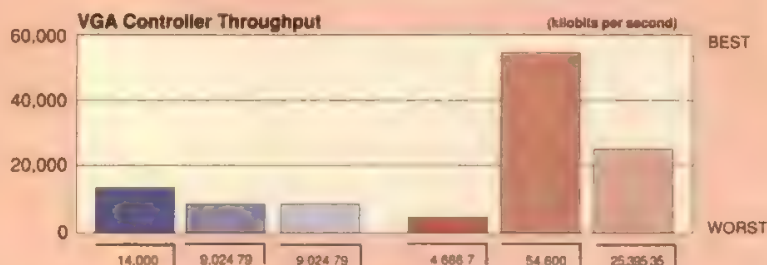
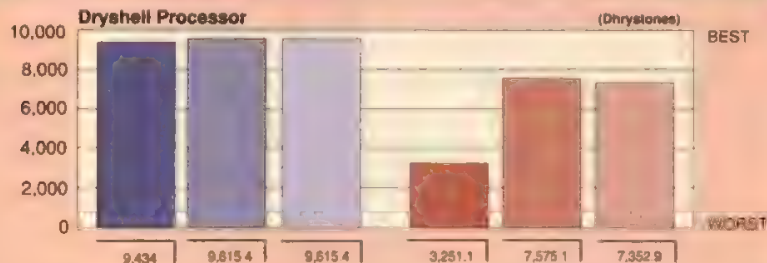
The **Disk Controller Throughput Writing Large Blocks** test is the same as the above reading test except that this test writes the sequential file instead of reading it. Keep in mind that reading is almost always faster than writing, because writing requires the operating system to update its file allocation table (FAT) or the equivalent.

The **Disk Controller Operations Reading Small Blocks** test reads a sequential file containing 2,048 blocks, where each block is a 512-byte record, and measures the maximum number of disk operations per second. Since the low-level PC hard disk format does not permit reading or writing less than a single 512-byte sector at once, this test determines the peak number of operations per second that a disk controller can sustain.

The **Disk Controller Operations Writing Small Blocks** test is the same as the above reading test except that this test writes the sequential file instead of reading it.

CONTROL GROUP

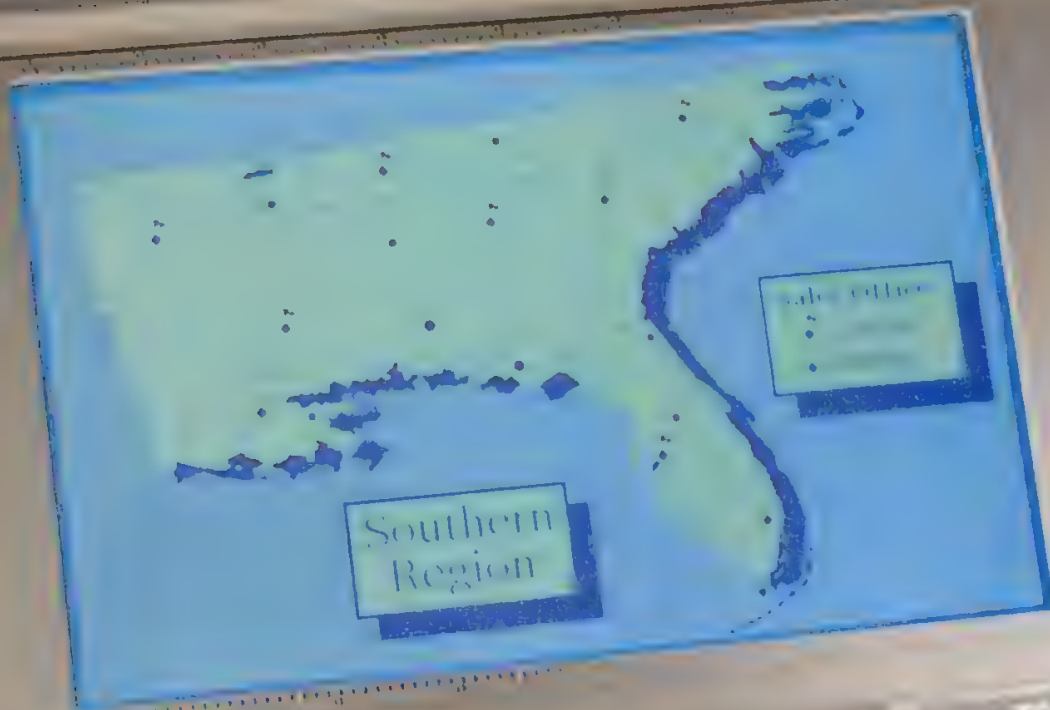
ENHANCED MACHINES



ALR Power Cache 4 (MCA)
ALR Power Cache 4e (ISA)
ALR Power Cache 4e (EISA)
IBM PS/2 Model 80-111 (MCA)
Everex Step 386/33 (ISA)
Compaq Systempro (EISA)

CONTINUES

T1000SE



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Introducing the first notebook PC that doesn't leave room for compromise.

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The 1.44MB 3.5-inch diskette drive is an industry standard.

Unlike most notebooks, the T1000SE has a built in 144MB 3.5-inch diskette drive, the industry-standard media that ensures compatibility with existing systems.

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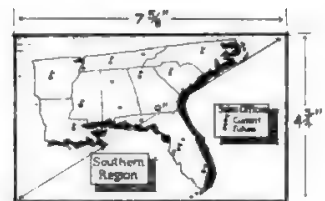


Ergonomically sculptured keyboard with a look and feel you're already familiar with.

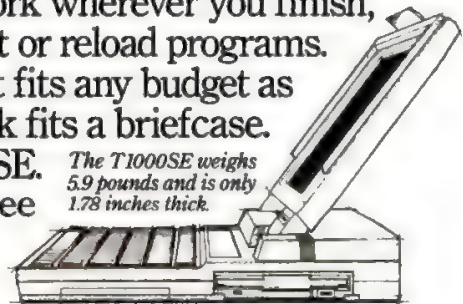
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PERFORMANCE TESTS: COMPOSITE VIEW

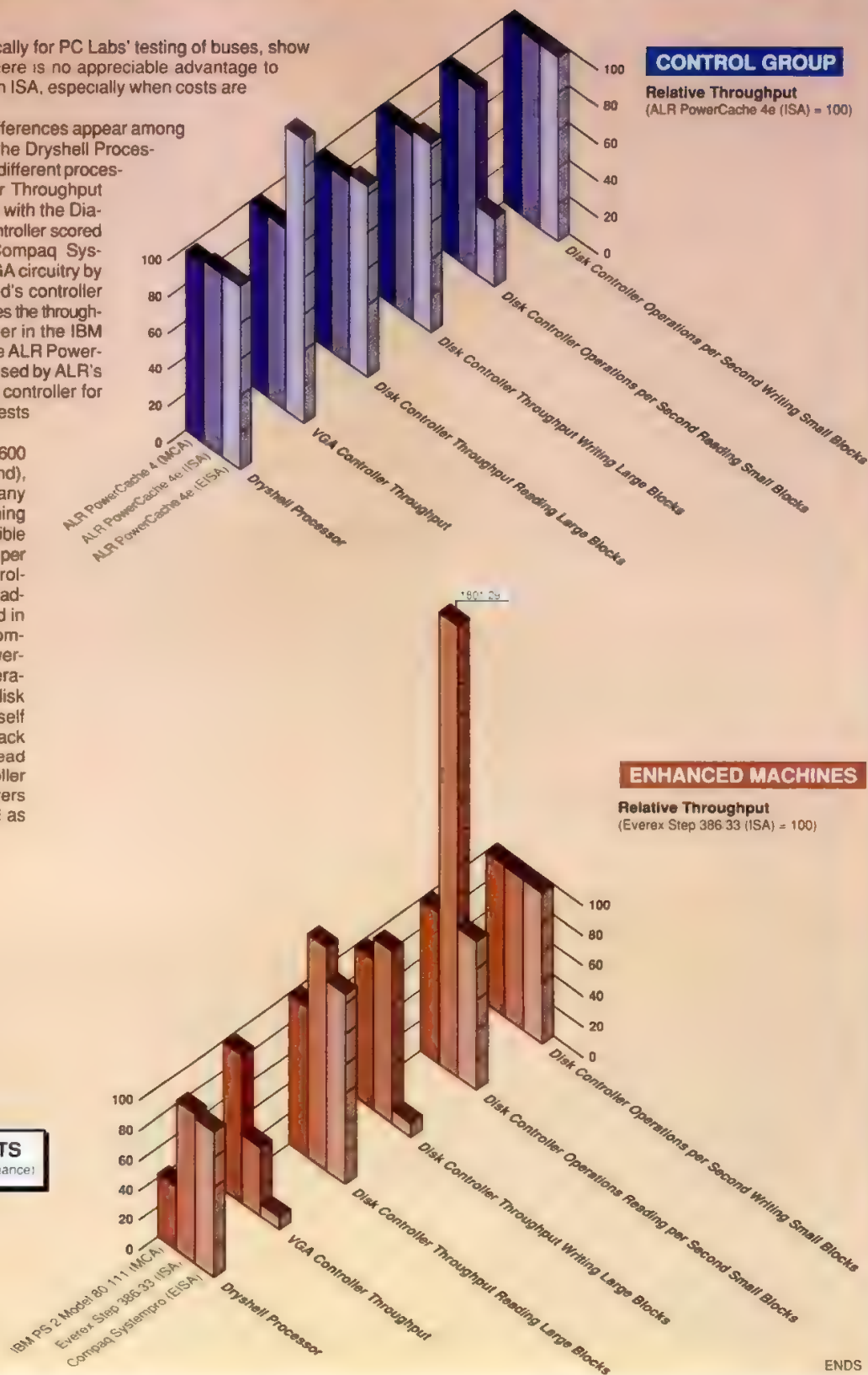
These tests, created specifically for PC Labs' testing of buses, show that for single DOS users there is no appreciable advantage to choosing a system other than ISA, especially when costs are factored in.

Although performance differences appear among the enhanced machines on the Dryshell Processor test, this is caused by the different processors. On the VGA Controller Throughput test, the Everex Step 386/33 with the Diamond SpeedSTAR Video Controller scored impressively, besting the Compaq Systempro's integrated 16-bit VGA circuitry by 115 percent. In fact, Diamond's controller achieved more than eleven times the throughput of the 8-bit video controller in the IBM PS/2 Model 80. The gap in the ALR PowerCache 4 and 4e results is caused by ALR's optimization of the 4's video controller for graphics, which is what our tests stress.

Most hard disks rotate at 3,600 rpm (60 revolutions per second), which means that without any assistance from disk-caching schemes, the maximum possible performance is 60 operations per second. Since the Disk Controller Operations per Second Reading Small Blocks test resulted in far higher scores for the Compaq Systempro and ALR PowerCache 4e (roughly 1,000 operations per second), either the disk controller or the disk drive itself reads and caches a full track whenever the first sector is read from the track. Disk controller and disk drive manufacturers typically refer to this method as track buffering.

THROUGHPUT TESTS

(Taller bars mean better performance)



ENDS

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PC Magazine



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*PC Magazine, On why the ZEOS®
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☐ UPS ground add \$35.00

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ORDER

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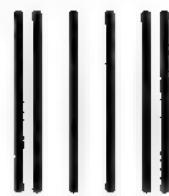
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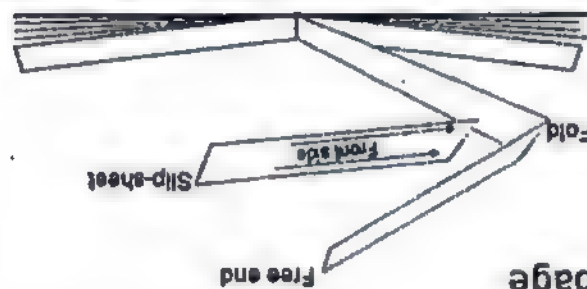
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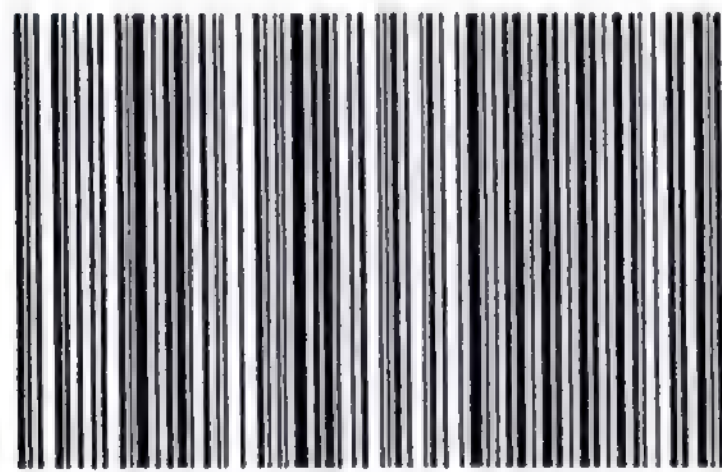
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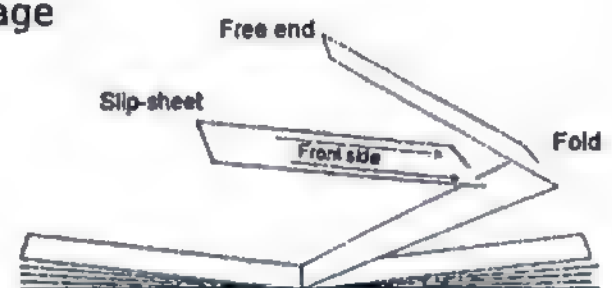


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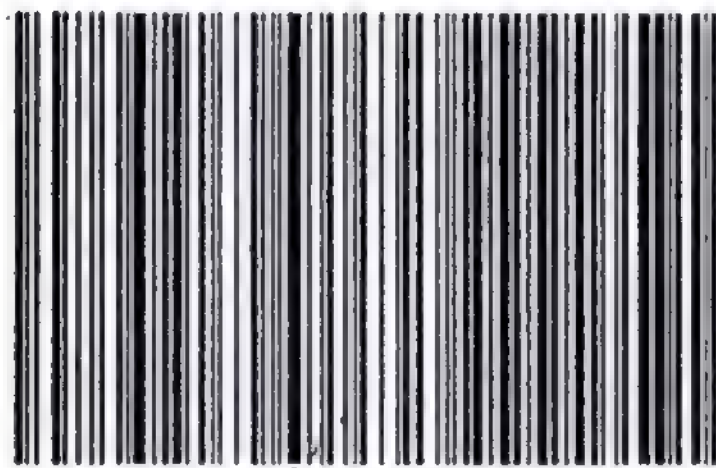
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Back

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Editor's Choice! "ZEOS comes in a winner... The fastest SX tested... packing plenty of value... great expandability, quality parts and down to earth pricing... how could you go wrong?" *PC Magazine, Editor's Choice.*

How could we say it any better? You simply can't go wrong. The ZEOS 386SX is the best you can buy.

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Performance. Quality.

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386SX**

YOU WANT PERFORMANCE? THIS IS IT!

ZEOS has invested literally thousands of hours creating the world's finest 386SX.

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This is no rehashed '286 design. It's a true '386 from the ground up. A Rock Solid Investment that runs circles around everything else out there.

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QUALITY YOU CAN COUNT ON. ZEOS QUALITY.

Your ZEOS 386SX is designed and manufactured right in our own laboratories. We have used only the *very best* components available. From the power supply right thru to the video, every component is absolute top quality.

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And if you're a VGA buyer you'll absolutely *love* our VGA display. As *PC Magazine* said "the ZEOS VGA display and card prove to be one of the fastest overall... tying with the Compaq Deskpro 386S." Now that's *hot* video!

Even the floppy drive. Yours will be a genuine Teac®. They cost a lot more but you simply can't buy better. ZEOS systems. Quality from the ground up.

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Incredible is the word! How can we build your

10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence?"

As *PC Magazine* said "Price is always a consideration. So are bench mark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but three times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editors Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent.



Value: Excellent."

Personal Computing said, "ZEOS... is the best value we've come across... its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5

Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6

24 Hour Toll Free Technical and Sales Support.

At ZEOS, the customer is #1. That's why we're open around the clock. For your convenience. If you buy a product from us we feel we should be there to help, 24 Hours a day. Our Help Lines are Toll Free too. Because you shouldn't have to pay for the call.

Reason #7

Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9

Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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Reason #10

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When it comes right down to it, you're going to be very satisfied with your new ZEOS system. Our goal is your complete satisfaction. And that's our commitment to you. To quality. To performance. To reliability and support. To *Value*. We don't just say it, we *Guarantee it!*

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NETWORK ADAPTER THROUGHPUT

NETWORK BENCHMARK TESTS:
EISA VS. ISA VS. MCA

All of our work in preparing this article convinced us that for up to 12 workstations, the best value for your investment in servers lies with ISA.

The **Network Adapter Throughput** test measures the throughput of the network adapter when installed in a node. The tested machine's network adapter card is bombarded by very large blocks of data that are sent across the LAN by three other 386 ISA PCs. Novell's *NetWare 2.15 IPX* (Internet Protocol Exchange) with Novell NetBIOS emulation provides the software underpinnings for this test.

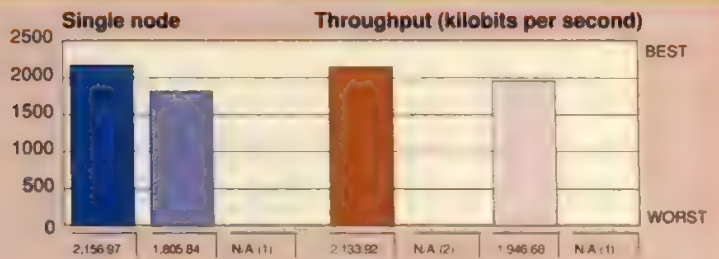
The **Network Throughput Under Load** test loads network cards, media, and access protocols but places a small load on the server. While the timed station transfers files, load stations read and write 1-byte data files, creating a high volume of data packets and increased activity on the network.

To obtain the Network Throughput Under Load figures, we run a general test program performing a sequential create, a sequential read, a sequential write, a random read, and a random write of a large file. The record sizes used in these activities systematically rotate among 16K, 4K, and 512 bytes. Usually a 1MB file is used, but this size may be adjusted for unusually fast or slow networks.

While the general test program is run, we load the network with the Network Throughput Under Load program. The results shown represent the average throughput over a period of time sufficiently long to ensure consistency.

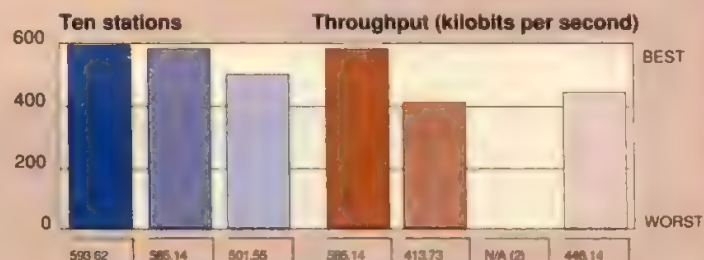
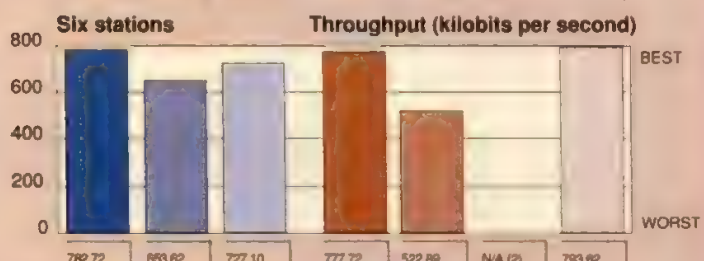
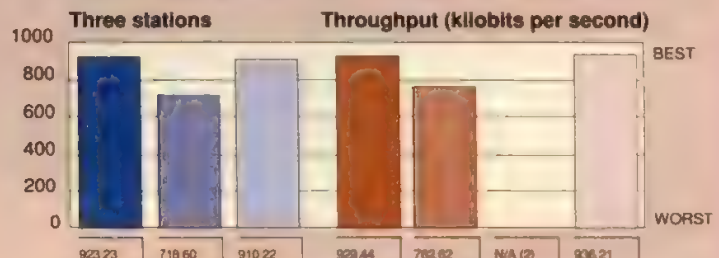
CONTROL GROUP

ENHANCED MACHINES



ALR PowerCache 4 (MCA)
ALR PowerCache 4e (ISA)
ALR PowerCache 4e (EISA)
IBM PS/2 Model 80-11 (MCA)
Everex StepServer/Storage Dimensions Filemaster (ISA)
Everex Step 386/33 (ISA)
Compaq Systempro (EISA)

NETWORK THROUGHPUT UNDER LOAD



ALR PowerCache 4 (MCA)
ALR PowerCache 4e (ISA)
ALR PowerCache 4e (EISA)
IBM PS/2 Model 80-11 (MCA)
Everex StepServer/Storage Dimensions Filemaster (ISA)
Everex Step 386/33 (ISA)
Compaq Systempro (EISA)

N/A (1)—Not applicable: this configuration could not complete the test

N/A (2)—Not applicable: this configuration was not used for this test

CONTINUES



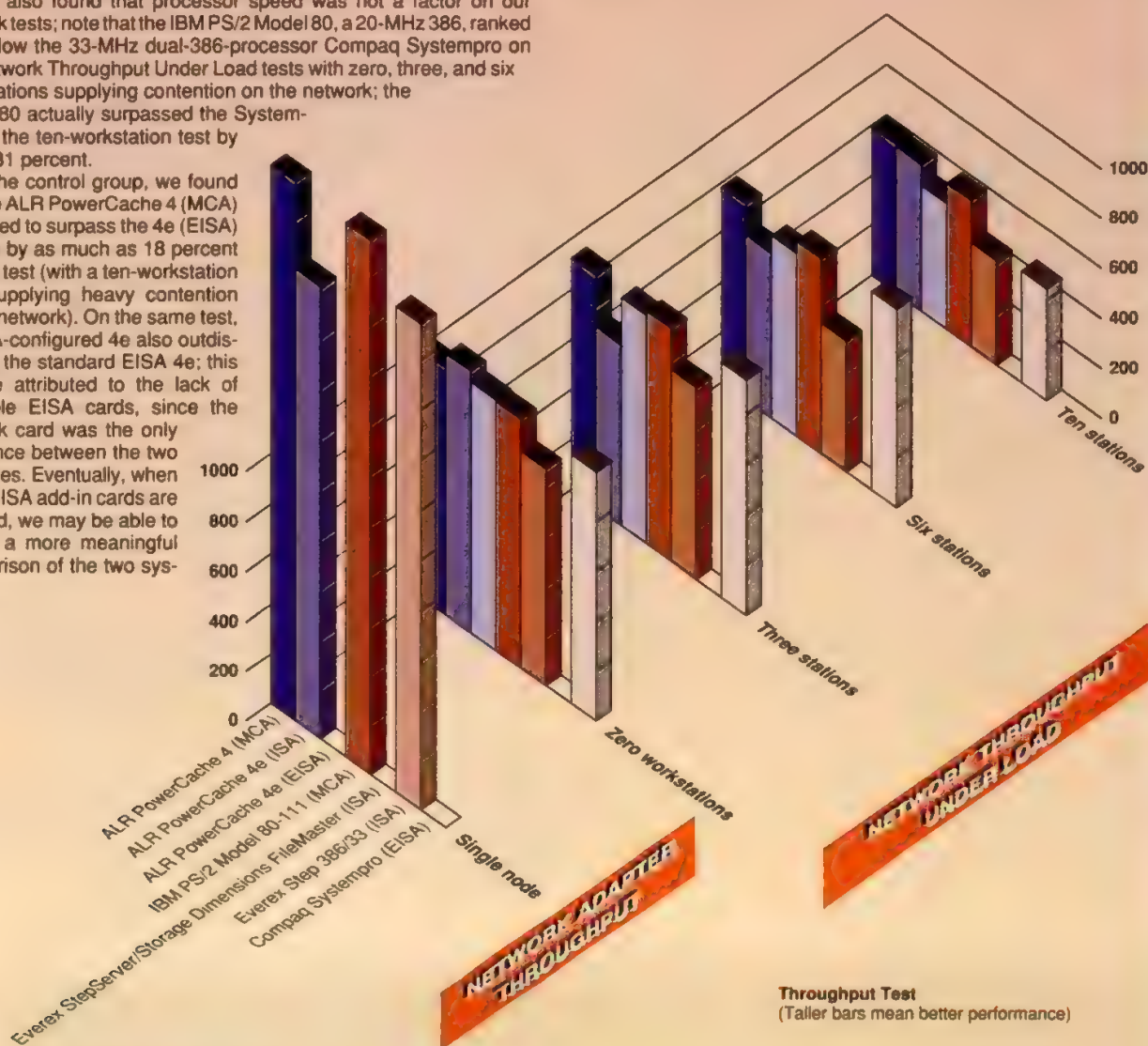
NETWORK BENCHMARK TESTS: COMPOSITE VIEW

In evaluating bus technology for network servers, we took into account not only the test scores but the cumulative experience of PC LAN Labs and our team of reviewers. We are convinced that for networks with up to 12 workstations, EISA and MCA offer no significant advantage over ISA to offset their extra cost. When going to larger networks you will start to see the benefits of these newer architectures, as foreshadowed by their scores on some of the performance tests. It is also likely that EISA throughput will eventually improve as more boards become available.

We also found that processor speed was not a factor on our network tests; note that the IBM PS/2 Model 80, a 20-MHz 386, ranked just below the 33-MHz dual-386-processor Compaq Systempro on the Network Throughput Under Load tests with zero, three, and six workstations supplying contention on the network; the Model 80 actually surpassed the Systempro on the ten-workstation test by about 31 percent.

In the control group, we found that the ALR PowerCache 4 (MCA) managed to surpass the 4e (EISA) system by as much as 18 percent on one test (with a ten-workstation load supplying heavy contention on the network). On the same test, the ISA-configured 4e also outdistanced the standard EISA 4e; this can be attributed to the lack of available EISA cards, since the network card was the only difference between the two machines. Eventually, when more EISA add-in cards are shipped, we may be able to supply a more meaningful comparison of the two systems.

In our Network Adapter Throughput test, where the machines were configured as nodes on a network rather than servers, we were not able to report results for the PowerCache 4e for lack of an Ethernet EISA card that could complete our tests. Thus, we were looking at just two computers in each group, but the results may be revealing. The MCA machine outpaces its ISA competitor by a margin of over 19 percent for the control group and nearly 10 percent for the enhanced machines.



Multitasking without tears.

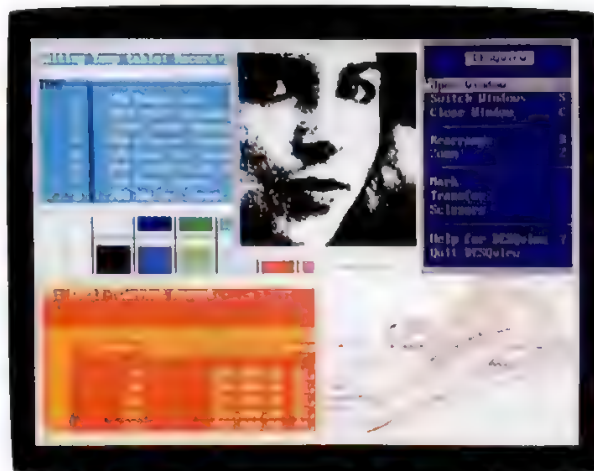
Thank goodness complicated programs like Microsoft Windows and OS/2™ aren't the only way to multitask and window on the PC.

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Introducing DESQview 2.26 It gives you greater productivity by multitasking more programs

The latest generation of DOS programs is getting better at using memory. Lotus 1-2-3 v2.2 and Release 3, Metro, Freelance, Microsoft Word, AutoCAD 386, Ventura Publisher



Professional—all are smarter about using memory. And DESQview 2.26 makes them work even better.

Mice are steadily becoming more popular, and v2.26 provides improved support for mouse menus within windows. At the same time, it also provides much greater flexibility for assigning and reassigning special keys within windows.

Our users asked for more support for 3270 and other terminal emulation. DESQview v2.26 has it.

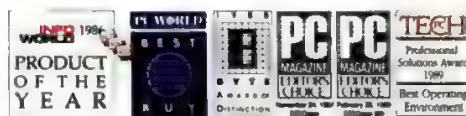
You asked for support for a wider range of hardware: CD-ROM, scanners, comm ports, etc. v2.26 has it.

And you asked for help in handling troublesome TSRs. DESQview helps straighten them out.

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DESQview System Requirements: IBM Personal Computer and 100% compatibles (with 8086, 8088, 80286, or 80386 processors) with monochrome or color display; IBM Personal System/2 • Memory: 640K recommended, for DESQview itself 0-145K • Expanded Memory (Optional): expanded memory boards compatible with the Intel AboveBoard, enhanced expanded memory boards compatible with the AST RAMpage; EMS 4.0 expanded memory boards • Disk: two diskette drives or one diskette drive and a hard disk • Graphics Card (Optional): Hercules, IBM Color / Graphics (CGA), IBM Enhanced Graphics (EGA), IBM PS/2 Advanced Graphics (VGA) • Mouse (Optional): Mouse Systems, Microsoft and compatibles • Modem for Auto-Dialer (Optional): Hayes or compatible • Operating System: PC-DOS 2.0-4.0, MS-DOS 2.0-3.3 • Software: Most PC-DOS and MS-DOS application programs, programs specific to Microsoft Windows 1.03-2.1, GEM 1.1-3.0, IBM TopView 1.1 • Media: DESQview is available on either 5-1/4" or 5-1/2" floppy diskette.

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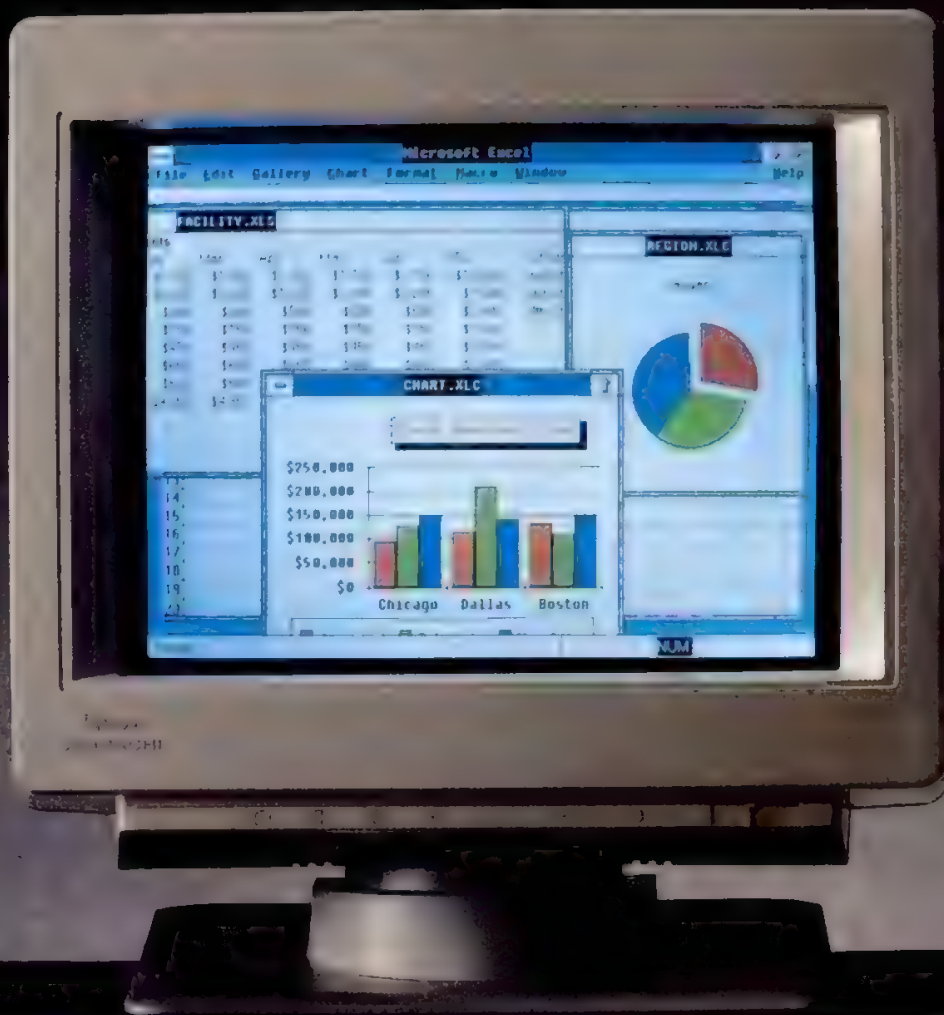
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	QEMM-386 Expanded Memory Manager version 5.0	☐			\$99.95	
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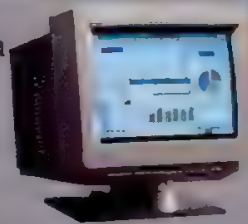


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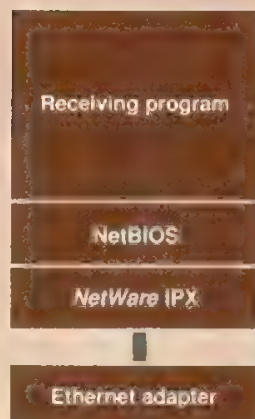
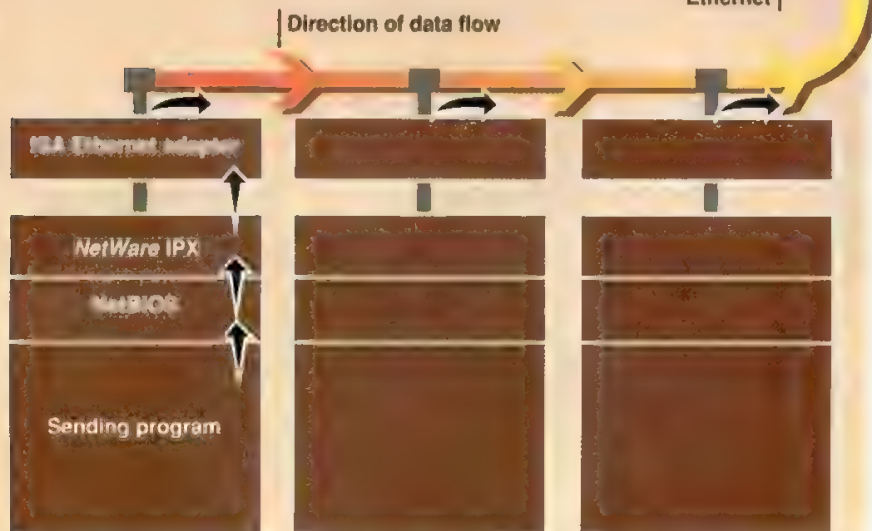
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BOMBARDING THE BUS: THE TESTING PROCESS

The Network Adapter Throughput test is a good measure of a PC's ability to operate in a network environment. If you invest in a high-end EISA or MCA machine the chances are you'll use it as a server.

In this test, the PC operates as a node on a network. Copies of the sending program running in three Compaq Deskpro computers bombard the target PC's LAN card with packets of data. The receiving program in the target PC takes the data from the LAN card as quickly as possible, allowing it to receive additional packets. This setup, intentionally bereft of accesses to other devices, isolates the LAN card in the target PC and measures the throughput of the LAN card and its supporting driver.—Ben Myers

Target PC
(MCA or ISA)10-megabit
Ethernet

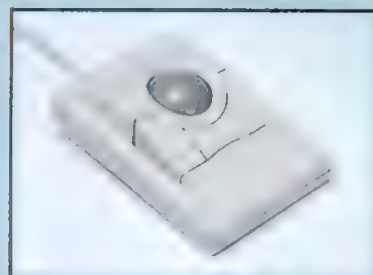
Source PCs (Compaq Deskpro 386/25s)

more time to take care of other work. Relieved of the responsibilities of bus control, the microprocessor in a bus-mastering system has the potential to carry out its functions faster. Moreover, the mastering design allows many separate but equal (or even unequal) microprocessors to be plugged into expansion slots. Such designs can theoretically offer multiprocessing and parallel processing inside the chassis of a single PC. With several microprocessors passing data around, an increased bandwidth is called for, probably more than the classic AT expansion bus can supply.

Bus mastering is thus the best justification for the existence of advanced bus designs and their very high bandwidths. Unfortunately, the number of Micro Channel bus-mastering expansion boards available today is minuscule, particularly when you consider how long Micro Channel computers have been available. This scarcity presumably stems from several causes. Bus-mastering expansion boards are inherently more complex and difficult to design. Soldering some components to a sheet of glass epoxy is just not enough. Bringing a bus master to life also requires

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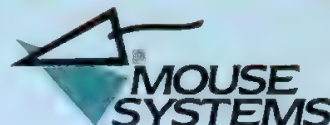
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ProWriter C-510/C-515 24-Pin Sophistication.

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The C-610+ has 240/100/80 cps draft/NLQ/LQ performance and 360 x 180 dpi graphics. The C-645 bumps up draft and NLQ output to 480 and 120 cps. The C-610+'s Epson and IBM emulations include the LQ-850 and ProPrinter X24/XL24, and the C-645 takes on the FX286e and ProPrinter XL24.



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programming expertise to develop the software that controls its operation.

The market for bus-mastering expansion boards is also small, giving board developers less incentive to develop new products. The total installed base of Micro Channel computers in the United States is



about 3 million—versus around 23 million classic-bus computers. As we go to press, the installed base of EISA computers numbers in the thousands.

Even if you should find and buy a bus-mastering expansion board for your computer, you're apt to be disappointed. You won't see much of a performance difference. DOS and bus mastering are contrary concepts. DOS harks back to the days when it was amazing that a personal computer could do even one thing at a time. DOS forces programs that execute under it—which means every one of the significant PC applications you can buy today—to serialize all of their input and output operations. All the data that's pushed across the expansion bus has to march under the gun single file.

WHITHER TECHNOLOGY

Notwithstanding all of the above arguments, advanced bus designs are not the work of the devil. Nor are they a fraud foisted off on unsuspecting users by snake-oil salesmen. They do offer a substantial technological leap ahead of the classic AT bus—which means that a very limited quantity of current software and expansion hardware can take advantage of them.

Just remember that the classic AT bus is far from dead, and it remains a viable option for expansion, with the possible exception of high-end networks. While you won't be disappointed in the performance of either an EISA or Micro Channel personal computer, an ISA machine will do the job just as well and with far broader in-

dustry support and hardware options.

If you're opting for the most cost-effective high-performance strategy with today's DOS or smaller LANs, your best bet is to stick with the classic AT bus; as for the additional \$1,000 to \$2,000 you'd have paid for an advanced-bus computer, you can invest it in memory. Use the extra RAM as a software disk cache; you'll see more of a performance increase than you would get with the most advanced bus-mastering disk controllers, even those with a hardware cache. Should you change over to an advanced operating system, those extra bytes of RAM won't be wasted.

If you're in the market for a network server, even a 12-MHz 286 computer will deliver adequate performance, assuming that your LAN does not include more than a dozen workstations. (Strange as it may seem, you're likely to need more processor power in workstations than in the server!) Remember, *NetWare 286*, Version 2.15, runs in protected mode, so the advantage of using *NetWare 386* is small (about 10 to 15 percent in PC LAN Labs' testing).

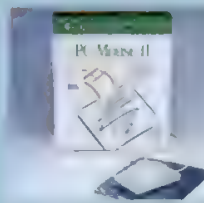
Large networks are another story. Along with multisystems—multitasking, multiuser, and multi-microprocessor computers—large networks benefit from the new bus designs. The software you need to tap that performance has been slow in arriving, but software has to come of age sometime. Even small networks will someday need more server power as more system functions are run on the server. When network monitoring, managing, or communications software lives on the server, you'll need all the processor power you can get.

Next on the PC Labs Bus Wars agenda is a test of the three bus architectures running under OS/2 and Unix, providing you with the picture outside the DOS world. By the time we finish, EISA may have done some growing, so that we can cross off the unavailability of boards from its list of troubles. For now, stop kicking yourself for not investing in the new and improved architectures for a single-user DOS environment. You can do without the bruises, and so can your wallet. ■

Winn L. Rosch is a contributing editor of PC Magazine. Ben Myers is an owner of Spirit of Performance Inc., a Harvard, Massachusetts-based firm specializing in benchmark tests and performance measurement.

COVER STORY BUS WARS

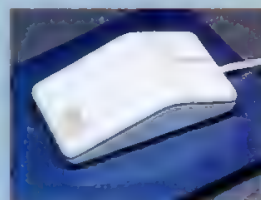
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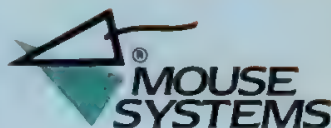
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THE

UTILITY

SHelf

Utilities are the glue that holds your PC together. Most everyone knows about *PC Tools Deluxe* and *The Norton Utilities*, and their ability to save your backside when you accidentally type `DEL *.WK?` instead of `DIR *.WK?`. There are dozens of other equally useful utilities. Some of them make life a little bit easier; others can save you enormous amounts of time, energy, and money.

This article presents 33 of the very best utilities. Together, they comprise the essential software shelf that no serious business PC user should be without. Some are useful every day; others may be called upon once in a blue moon. If you honestly value your time, all will earn back their costs the first few times you use them.

Thirty-three powerful programs that recover files, make sense of DOS commands, speed your hard disk, find files and text, enhance your display, keep your TSRs in line, diagnose your PC without popping the cover—and more. Much more.

BILL HOWARD

HOW WE PICKED THEM

Selection of these products reflects the consensus of two dozen *PC Magazine* editors and contributing editors over nearly six months of informal electronic mail and face-to-face discussions, culminating in a series of formal shakeout meetings, with frequent adjournments to PC Labs for side-by-side comparisons of the finalists. We also listened to input from *PC Magazine* readers on PC MagNet over the same period. They're every bit as passionate as we are about the value of utilities—hence, with apologies to A.J. Liebling, while freedom of the press belongs to the man who owns one, at *PC Magazine* it's influenced by all the people who own modems. When we were torn between products, our readers' input and insight tipped the scales in several cases.

MAINSTREAM UTILITIES

In picking these utilities, we opted for mainstream products that solve a range of common problems. We marked down products with arcane command-line-only structures that would save hackers five seconds (compared to a menu structure) while befuddling the bulk of the would-be user base. That means we passed over some of our own personal favorites because we believe that their appeal falls off once you get beyond the realm of power users and hackers. We also took a bye on product-specific utilities for spreadsheets, databases, and languages. They're useful, they're important, and they're likely topics for future articles, but not this one. Lastly, with *Microsoft Windows* in transition from version 2 to version 3, this isn't the time to write about *Windows* utilities: virtually all of them have to be rewritten for *Windows* 3. There will, however, be a healthy market for *Windows* 3 utilities. *Win* 3 is far easier to use than the erstwhile *Windows/286* and *Windows/386*, but there's still plenty of room for third parties to add value and function.

We pondered whether multitaskers or task switchers are utilities or something more heavy-duty and decided that they deserve deeper examination than this format allows. We'll review them later in the year. In the meantime, get Quarterdeck's *DESQview* or *DESQview/386* to juggle several programs; *Software Carousel* from SoftLogic Solutions is also worthwhile. If you're running several *Windows*-based applications, you're better off with *Windows* 3, which has enhanced the ease with which you can set up a graphical menuing system

for loading *Windows* and non-*Windows* applications.

As leading utility products like *PC Tools Deluxe* expand the number of tools they offer, we believe you're a bit less likely to turn to single-purpose utilities if they duplicate a function found in a more comprehensive product. Cases in point: Bridgeway Publishing's *FastTrax* and Multisoft's *PC-Kwik Power Disk*, the best of the disk optimizing, or disk defragmentation, utilities. Many users will find that the disk optimizing utilities in *PC Tools*, *Norton Advanced Utilities*, or *Mace* will suit them adequately, even if they're not quite on par with *FastTrax* and *PC-Kwik Power Disk*. Likewise, if you need an outliner, meeting organizer, and speech preparer, *Grandview* from Symantec is un-

paralleled, but there are capable outliners in an increasing number of word processors, including *Microsoft Word* and *Word for Windows*.

Business's goal of having fewer tools doing more tasks also means there's less maneuvering room today for the shareware or public domain utilities that typically furnish one specific tool. Had we done this article a year ago, they would have figured more prominently.

WHAT THEY AREN'T

It's important to understand what this article is not about, especially since vendors often trumpet positive reviews in *PC Magazine*. This is not a recap of *PC Magazine* Editor's Choice products, although many of the selections have been or likely will receive an Editor's Choice designation. Editor's Choice goes to products judged

BIG POWER IN SMALL PACKAGES: PC Magazine's All-Star Utility Lineup

by Edward Mendelson

Not everyone needs or likes the Swiss Army-knife approach that characterizes most commercial utilities, especially when the Swiss Army knife has grown into a complete place setting with a full menu. If you can navigate the DOS command line—and if you prefer the speed and elegance of small-scale utilities crafted in tight assembly language—you may turn to some of *PC Magazine*'s utilities instead of or in addition to their commercial big brothers. Another advantage of these compact programs is instant availability. You can download them all from PC MagNet or most BBSes.

Over a hundred programs, some of them instant classics, have been published in the magazine's Utilities column over the years. Among the best are Michael J. Mefford's directory managers, DR, RN, CO, and DIRMATCH. DR displays a sorted directory of files and lets you view or manipulate them with a keystroke. RN does the same for a tree of directories, and when you want to look into a directory's files, RN lets you run DR simply by pressing the Enter key. CO is a near-twin of DR designed for copying and moving files.

The best of all may be DIRMATCH, a unique utility that displays

two directories down the screen, with matching files shown on the same line. You can mark any group of files and copy or move them from one directory to the other. This indispensable program will save you more time—and keep you from overwriting more files that you wanted to keep—than anything you can buy.

Even a small command-line utility can offer multiple functions. BATCHMAN can control screen colors, alter the beeps, help create branching batch files, rename directories, report on memory, change the typematic rate of your keyboard, reboot your computer, report whether a set of files will fit on a floppy disk, and even reformat floppy disks in seconds. You'll need to know about DOS's ERRORLEVEL settings, but BATCHMAN makes the learning easy.

When you need a quick editor for batch files or anything else, you'll want TED, one of the smallest and easiest programs of its kind. It only has ten functions, all of them listed on the bottom-line menu, and the keystrokes are close enough to *WordPerfect*'s that you may not need the menu at all. This is one of the few editors that lets you enter the Escape character simply by pressing the Esc key.

the best in comparative reviews based on scripted benchmark testing in PC Labs and PC LAN Labs. The products here were picked by a consensus of expert opinion. Nor should this be confused with our first-of-the-year Best Of issue citing personal bests (editors' personal favorites among new and revamped products of the past year) or recipients of *PC Magazine's* Awards for Technical Excellence (technical breakthrough products of the past year) presented at Fall Comdex.

TIMES CHANGE

As the industry evolves, so do the utilities. Mid-1980s software wouldn't load across subdirectories, so IBM's FILEFAC was a godsend then and redundant now. Now that copy protection is primarily past-tense, you have little need for gems like *Copy II PC* from Central Point Software

For file management from the command line, nothing could be easier than REDirect and RENdir. The first lets you move files instantly from one directory to another; the second lets you rename directories. If you can copy or rename a file, you already know the syntax for these programs.

Equally valuable is NO, the program that tells DOS not to touch files you want to protect. Enter

NO *.doc DEL *.* *

at the DOS command line, and you'll save your documentation files from destruction while clearing out everything else.

One reason you may someday switch to OS/2 is DOS's inability to cut and paste data from one application to another. SNIPPER is the smallest utility that does the job for you. A couple of keystrokes cuts lines from one screen, saves them in RAM or a file, and pastes them into another screen later.

There is also—but the list seems almost endless. You'll want to look at SLICE, which lets you transfer files too large for a single floppy disk without making you bring along a backup/restore program too. You'll want ZCOPY for fast file transfers between two computers via a serial link. You'll want SCHEDULE for pop-up appointment book and alarm clock. And you'll

and Unlock from TranSec Systems. CP/M is a past-tense operating environment, so there's limited need for Xenosoft's *Xenocopy* to read CP/M disks. The current computer alternative, the Mac, reads 3.5-inch PC disks; or, you could use a file-transfer program or your network. And with keyboard macro facilities built into so many programs, there's less need for a program like Alpha Software's *Keyworks*.

This article is rooted in the here and now, describing the state of the art in mid-1990. For that reason, we're not going to rate the handful of OS/2 utilities because OS/2 has a year or two to go before it's a mainstream operating environment. Its time will come, and so will the utilities that help you use it. You'll see popular utilities posted over in the next year.

These single-task utilities from PC Magazine—fast, tightly coded, and free—perform many of the functions of their commercial counterparts. There are 13 of our favorites.

probably want a few dozen more. There's a full list of all the programs available on the PC MagNet Utilities Database; you can use them by downloading UDCAT.ARC.

If you haven't downloaded utilities from PC MagNet, it takes only a few minutes to learn the technique. Details on joining and accessing PC MagNet are on masthead page, just after the table of contents. ■

WHAT TO BUY FIRST: PC TOOLS

We're assuming you already own one or more of the mainstream DOS tools programs: *The Norton Utilities*, *PC Tools Deluxe*, or *The Mace Utilities*. If you don't, put down the magazine, pick up the phone, and place your order. *Norton* is the granddaddy of them all, and *PC Tools* in its current version (6.0) is arguably the best—today. All three received Editor's Choice when we reviewed them a few issues back ("Disaster Relief: DOS Utilities Save the Day," *PC Magazine*, March 27, 1990). All evolved from retrievers of accidentally deleted files into Swiss Army knives extraordinaire, with disk defragmentation, accidental-format recovery, and file and text location.

We continue to be amazed by the ever-expanding breadth of *PC Tools*. Version 6 adds shortcut commands that let power users use many of its tools directly from DOS, without the delay of loading the *PC Tools* shell first. (This drawback had kept in-a-hurry power users loyal to *Norton* and *Mace*.) Moreover, since *PC Tools* lets you run other applications from within it via a menu, it's a DOS menuing program as well. If you don't want to leave *PC Tools*, there's a passable word processor (although *WordPerfect* is in no immediate danger). As icing on the cake, *PC Tools* makes excellent use of a mouse. Along with *Norton Commander*, *PC Tools* shows how much you can benefit from having a mouse even if your software doesn't run in graphics mode.

STARTER KIT

We believe you'll benefit from having every one of these utility programs on your shelf, especially if you're charged with putting out brushfires in a department or a company full of cantankerous PC users. Some of these utilities may enhance your reputation as a wizard who knows all the answers. You're entitled to all the credit; we can keep a secret.

If you can't acquire every utility today, here's what we suggest for a starter kit covering seven essential categories.

First, get *PC Tools Deluxe* as your DOS toolkit, deleted-file retriever, DOS shell, DOS menuing system, disk cache, disk defragger, and bowling league statistics manager. (*Norton* and *Mace* are also perfect first utilities.) To find any piece of information anywhere on your hard or floppy disks, get Lotus's *Magellan*. Get *Mark/Release* to manage all your terminate- and stay-resident (TSR) utilities, as

well as to exit the network (and get back your memory) without rebooting your PC. If you've got more than a mega of memory on your 386 PC, get either Quarterdeck's *QEMM-386* or Qualitas's *386MAX* (pronounced 386 to the Max). If you back up to floppy disk, get Fifth Generation Systems' *Fastback Plus*, but give thought to tape backup, which costs more initially yet is less painful than feeding disk after disk to your floppy drive.

If you're a system administrator or if you're called upon to set up or diagnose PCs, get Dariana Technology Group's *System Sleuth* or Touchstone Software's *Check-It* (your pick). Keep tabs on potential viruses with John McAfee's *Scan*. Use

Fifth Generation's *The Brooklyn Bridge* to port everything from a user's old PC to his or her new machine and to transfer the contents of a laptop's hard disk to a desktop machine.

An important goal in creating this story was to publicize lesser-known utilities that help you use your PC faster, better, and smarter. If you don't know about a great utility, it's not going to be much help.

The article is arranged in groups by function: communications and networking products, disk utilities, general desktop utilities plus DOS menus and DOS shells, graphics utilities, keyboard enhancers,

memory managers, printer utilities, text and word processor utilities, video display utilities, and virus fighters. In a sidebar, we describe the most popular and useful of *PC Magazine's* own utilities, all available free, and useful single-purpose utilities that elegantly replace or supplement common DOS commands such as *TYPE* and *COPY*.

Lastly, if your favorite utility wasn't listed, remember that the opinions of *PC Magazine's* experts are still just opinions. In some categories, there may be a half-dozen products of nearly equal utility. In those cases, we've indicated runners-up, or honorable mentions, because we believe they deserve your attention, too.



File Transfer

The Brooklyn Bridge

DeskLink

When you want to move a dozen files between a laptop portable and a desktop PC, the most hassle-free method is to put a 3.5-inch floppy disk drive into your desktop machine and swap disks. Don't let anyone tell you otherwise. File-transfer programs do have their merits, though, especially when upgrading to a new PC: hook up old and new machines, set the subdirectory copy option to yes, engage copy, and when you come back from lunch, all the data from the old machine is on the new machine.

Of the file-transfer programs, the best of a closely packed lot are Fifth Generation Systems' \$139.95 *The Brooklyn Bridge*, or Traveling Software's \$169.95 *DeskLink* if you also want to share a printer among two PCs and send messages back and forth. You won't get any argument from us if you opt for Traveling Software's best-selling *LapLink III* (\$149.95) or *FastLynx*, formerly *FastWire* (\$149.95, Rupp Corp., (800) 852-7877 or (213) 850-5394). If you've got a Mac in the equation, get Traveling Software's *LapLink Mac III* (\$189.95).

File-transfer programs trick the serial port (and more frequently now, the parallel port) into running at speeds approaching that of a floppy disk. All include a null mo-

dem cable to connect the two machines; most let you work from a split-screen menu (local drive on one side, remote drive on the other) or the DOS command line, and most can be used to manage files on your hard disk. Caution: before you use any program, read the instructions carefully if your machines use different versions of DOS or if either one has a hard disk bigger than 32MB. You could corrupt a file or your disk.

We especially like *The Brooklyn Bridge* for its sophisticated command-line mode. Some users may find *Bridge* tough to install and use, though. That's a common complaint with these packages. The imprecise *LapLink* interface makes it easy for users to accidentally copy from machine B to machine A when they thought they were copying from A to B.

DeskLink may be the world's most idiot-proof B.S. LAN, so named because it's commonly used to link the PCs of the boss and secretary, letting them read and write files from each other's hard disks, share a printer, and send brief messages. *DeskLink* does all this in the background (e.g., while you're running another program); the other transfer utilities can't do that as well. As a bonus, *DeskLink* uses easily hidden standard telephone cable between the serial-port connections.

You'll also find file-transfer abilities built into an increasing number of multi-purpose utilities, including Central Point Software's *PC Tools*, Peter Norton Computing's *The Norton Commander*, and Datastorm Technologies' *ProComm Plus*.

The Brooklyn Bridge, Version 3.0. Fifth Generation Systems Inc., 10049 N. Reiger Rd., Baton Rouge, LA 70809; (800) 873-4384, (504) 291-7221. **List Price:** \$139.95.

Requires: 5K RAM, DOS 2.0 or later. **Last Reviews:** April 24, 1990, page 194; February 27, 1990, page 43.

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DeskLink, Version 2.21d. Traveling Software, 18702 N. Creek Pkwy., Bothell, WA 98011; (800) 662-2652, (206) 483-8088. **List Price:** \$169.95. **Requires:** 128K RAM, DOS 3.xx or later. **Last Review:** April 24, 1990, page 195.

CIRCLE 602 ON READER SERVICE CARD

Network Utilities

Disk Manager-N

Navigate

Every *NetWare* LAN Supervisor who might do more than one *Advanced NetWare* 286 or *NetWare ELS* installation a year should have a copy of OnTrack's *Disk Manager-N*. This package handles disk formatting for *NetWare* and does it better than any Novell utility. It's particularly handy when you back up and reformat your Novell server's drive, as you should do periodically to remove fragmented files and improve performance.

A file- and resource-management package, *Navigate* is a steal at \$195. Anybody on the network who maps to more than a few drives finds that *Navigate* lets him or her easily examine, tag, move, delete, and otherwise manage servers, volumes, subdirectories, and files. *Navigate* includes the ability to change the attributes of those files that were marked read-only when someone shut down an application without closing files. Plus it gives you a wealth of information on the drives. Versions are available for *NetWare*, *NetBIOS*, and other network software systems.

Disk Manager-N, Version 3.10. OnTrack Computer Systems, 6321 Bury Dr.,



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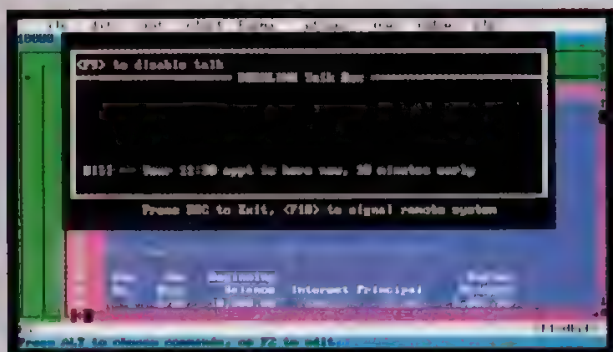
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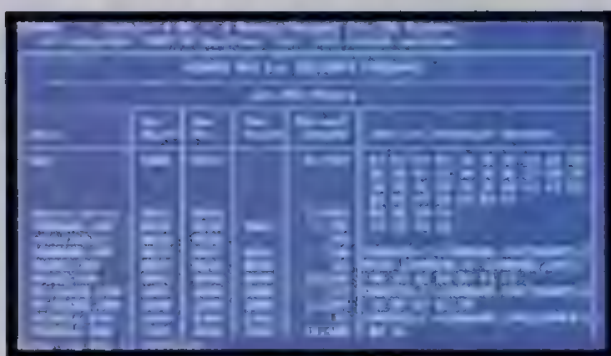
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Traveling Software's \$169.95 *DeskLink* is a file-transfer program that lets two users share a printer and pass simple messages. *DeskLink* is great for transferring the contents of your old PC to a new one, too.

Qualitas's \$129.95 *386MAX Professional* memory manager provides more room for your programs. If you're on a network, *386MAX* and Quarterdeck's *QEMM-386* can be a godsend.



#15-19, Eden Prairie, MN 55346; (800) 752-1333, (612) 937-1107. **List Price:** \$249.95. **Requires:** 512K RAM. Not recently reviewed.

CIRCLE 603 ON READER SERVICE CARD

Navigate, Version 1.2. Performance Technology, 7800 IH 10 West, San Antonio, TX 78230; (800) 825-LANS, (512) 349-2000. **List Price:** \$195 (for Banyan, \$295). **Requires:** 200K RAM, DOS 3.1 or later. **Last Review:** December 12, 1989, page 391.

CIRCLE 604 ON READER SERVICE CARD

Phone Dialer

Hot Line

Dozens of utilities have pop-up, terminate-and-stay-resident phone dialers; most are a pain to use compared with *Hot Line* 2.2 (\$99 from General Information). *Hot Line* lets you maintain six phone directories, typically including a personal directory, an internal corporate directory, and a business-related directory. *Hot Line* includes a list of 10,000 business phone numbers, and, for \$79 to \$249, you can buy seven specialized directories including public relations, high tech, colleges, toll-free, or 25,000 corporate numbers. It's the bells and whistles that set *Hot Line* apart: it's

one of the few programs smart enough to strip the area code if the area code you're calling from is the same as the one you're calling. You can look up a city or an area code, time calls, and write a call log to disk. With expanded memory, *Hot Line* needs only 3K of memory (97K otherwise) and uses standard *dBASE*-format .DBF data files.

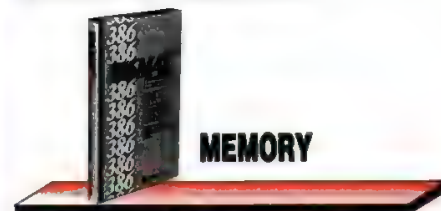
Nobody's perfect, however: configuration is overly complex; there's no easy way to blend two *Hot Line* directories into one; and *Hot Line*'s limited print routines make the creation of mailing labels and printed phone directories a Grade A hassle. (The solution for this utility is yet another utility: the *PrintBase* version of *Books, Cards and Labels*, an elegant database-file printer with infuriatingly cryptic documentation (\$129.95, Useful Software Inc., (818) 880-4001).

Outside of a pop-up notepad added with the recent version, *Hot Line* is past due for a major upgrade. Creaky as it is, however, nothing else comes close, which shows *Hot Line*'s fundamental soundness.

Hot Line, Version 2.2. General Information Inc., 11715 N. Creek Pkwy South, #106, Bothell, WA 98011; (800) 722-3244, (206) 483-4555. **List Price:** \$99; directories, \$79

to \$249. **Requires:** 87K RAM (3K with expanded memory), DOS 2.0 or later, Hayes-compatible modem. **Last Review:** May 15, 1990, page 46.

CIRCLE 605 ON READER SERVICE CARD



MEMORY

Memory Management, Diagnostics

QEMM-386 386MAX

While you're waiting for OS/2 to get real and give you gobs of well-behaved memory for multiple programs, you can make the most of what you've got with a memory manager such as *QEMM-386*, Version 5.0, from Quarterdeck Office Systems or *386MAX* from Qualitas, for 386-based PCs. Both programs move device drivers and TSR (terminate- and stay-resident) utilities into memory above the first 640K, leaving more room in the first 640K for programs and data to operate. They also convert extended memory (the memory you have beyond the first megabyte) into LIM 4.0-compatible expanded memory. You may also be able to remap your system's ROM BIOS and your graphics card's video BIOS into faster RAM. Perhaps the biggest specific advantage with these two products: DOS, your network software, and a bulky application program can finally run together.

Which product is better? They're so closely matched, the advantage often belongs to whichever has the most recent update. Currently, *QEMM-386*, at \$99.95, does a bit more and does it automatically. *QEMM* frees more low memory but can run you into conflicts. *386MAX* (also spelled, cutely, as *386 Max*), \$129.95, refuses to load LASTDRIVE, FILES, and FCBS (file control blocks) CONFIG.SYS statements into high memory because Qualitas believes that their workings are too closely intertwined with DOS.

QEMM-386 includes *Manifest*, a superior system analyzer that Quarterdeck also sells separately for \$59.95. (If you've got *Manifest*, you've got virtually the equivalent of *Check-It* and *System Sleuth*, described in the diagnostics and setup section of this article.) *QEMM-386*, in turn, is included with Quarterdeck's *DESQview*, a

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April 1989

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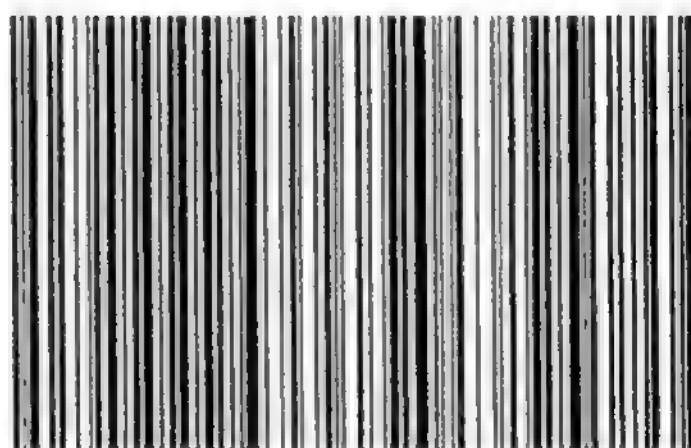
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110MB (19ms)	\$2129	\$2094	\$2324

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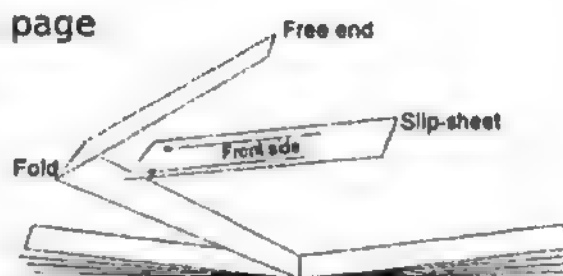
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Inverted Foldout slip-sheet

Foldout slip-sheet

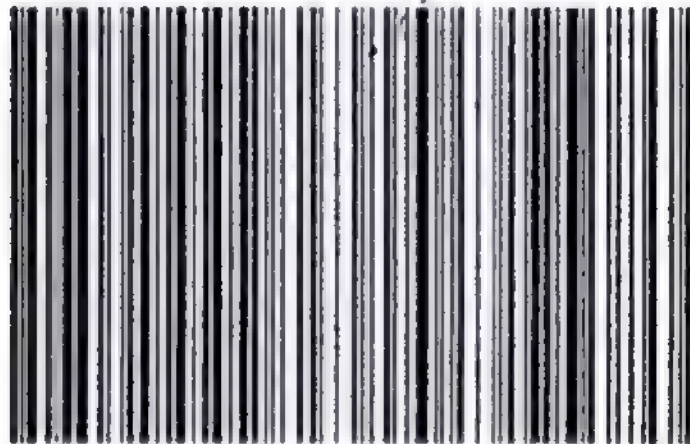
1. Open the foldout page
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multitasking operating environment that provides a stable platform for switching among multiple tasks without the flashiness of—and with a bit more system stability than—Microsoft's *Windows/386*. To make clear the differences among Quarterdeck's products: *Manifest* analyzes your system, *QEMM-386* manages memory, and *DESQview 386* allows you to run multiple tasks on a 386 PC.

If you've only got a 286 PC, consider *Above Disc*, Version 3.1 (\$119, Above Software Inc., (800) 344-0116, (714) 545-1181), which provides many of the TSR remapping services of *QEMM-386* and *386MAX*. Also look into the *All Charge Card*, a comparatively pricey hardware-based memory manager and remapper (\$399-\$499, All Computer Inc., (800) 387-2744; (416) 960-0111).

If your memory management needs are limited to creating LIM 4.0 expanded memory from extended memory, *PC Magazine* offers *EMS40.SYS*, a free utility on PC MagNet, or you might try commercial utilities such as *Turbo EMS*, Version 5.04.2 (\$99.95, Merrill & Bryan Enterprises, (619) 689-8611). Virtually all add-in memory cards offer EMS 4.0 support in hardware or software; if you have an older board that supports only LIM 3.2, you can get a software upgrade. And DOS 4.0, of course, contains built-in LIM 4.0 support.

QEMM-386, Version 5.0. Quarterdeck Office Systems, 150 Tico Blvd., Santa Monica, CA 90405; (213) 392-9851. **List Price:** \$100. **Requires:** 640K RAM, DOS 2.0 or later, hard disk recommended. **Last Review:** March 27, 1990, page 35.

CIRCLE 427 ON READER SERVICE CARD

386MAX, Version 4.08. Qualitas Inc., 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; (800) 733-1377, (301) 907-6700. **List Price:** \$129.95. **386MAX**

Professional: \$74.95 for basic product.

Requires: 64 bytes of low DOS memory, 1 to 3K of high DOS memory, 180 to 250K of extended memory, DOS 3.0 or later. Not recently reviewed.

CIRCLE 428 ON READER SERVICE CARD

TSR Memory Manager

Mark/Release

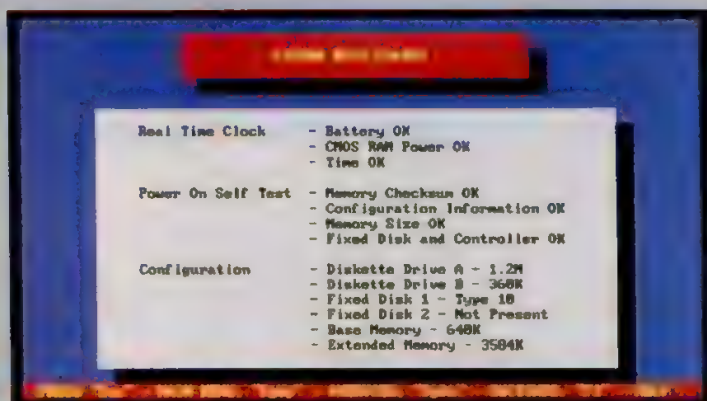
TSR managers let you load and unload multiple RAM-resident programs such as *SideKick Plus* and *Metro* with less chance of conflicts. Here, the best things in life are free: *Mark/Release* utilities are free but copyrighted programs from Turbo Power Software. You can download them from

PC MagNet on CompuServe (TSRC29.ZIP in Library 2 of the Utilities Forum) and elsewhere. Before you load a TSR, run *Mark*; afterwards, run *Release*. *Mark/Release* also works with network operating systems, so now you can unload Novell's *NetWare* without rebooting. *Mark* takes up only 1.5K of memory.

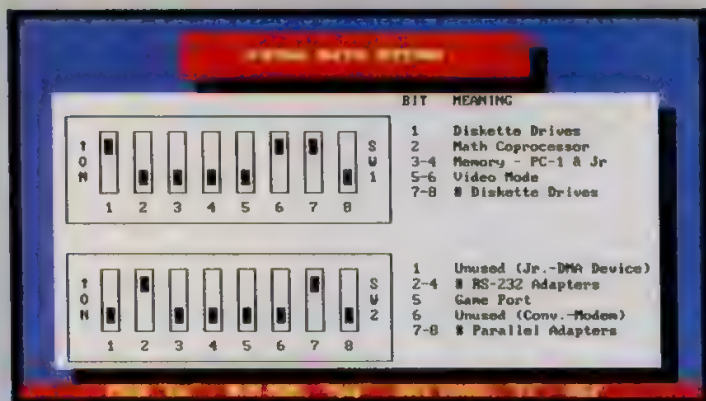
Commercial TSR-manager alternatives, all useful and perhaps easier to acquire if you're more adept at walking into Egghead with a credit card than navigating the maze of a bulletin board: *PopDrop*, Version 3.1B, and *PopDrop Plus*, Version 1.0C (\$49.95 and \$99, respectively; Bloc Publishing, (800) 88T-IGER, (305) 445-6304) and *Referee*, Version 1.0C (\$69.95, Persoft Inc., (608) 273-6000).

Mark/Release, Version 2.9. Turbo Power, P.O. Box 66747, Scotts Valley, CA 95066; (408) 438-8608. **List Price:** \$20 or free if downloaded. **Requires:** 256K RAM, DOS 2.0 or later. Not recently reviewed.

CIRCLE 429 ON READER SERVICE CARD



System checkout utilities report on what's inside a PC and how it's functioning—without ever popping the cover. The \$149 *System Sleuth* reports on system configuration, memory, interrupts, disk types and capacities, and system switch settings.



DIAGNOSTICS, SETUP

Check-It System Sleuth

Diagnostic and setup utilities tell you what's inside your PC: how much memory you have, what connections and interrupts are in use, what drives you have. They can test system components and help find bad memory chips. If part of your job is helping other users keep their machines in order, products such as *Check-It 2.1* from Touchstone Software and *System Sleuth* from Dariana Technology Group can make you look like a genius. These products save time, money, and frayed relationships.

UTILITIES THE 33 BEST

Ask a PC user if you can peek under the hood of his or her machine and you're likely to be told, "Not in my system, you can't. Anyway, right now I can't spare it for 20 minutes . . . this afternoon I'm using it for . . . and tomorrow—well, there's just no way I'm going to let you go digging around in there."

And even if the user doesn't mind a PC manager rummaging around inside a machine, sometimes the PCs are tucked under desks or in corners or under laser printers where it's no mean feat to simply pop the hood. *Check-It* and *System Sleuth* offer users the PC equivalent of noninvasive surgery: when you stick in the magic disk and get the machine to cough up its rank, serial number, and a whole lot more, there's a "wow!" factor that builds your credibility.

Check-It and *System Sleuth* are god-sends when installing network cards. While every LAN administrator *should* have a three-ring binder with a page per PC detailing add-in boards, the interrupts they hook, where I/O memory sits, and so forth, that's not likely to be the case. That's why they need to keep these products around.

Unlike most of the other utilities that are reviewed here, *Check-It* and *System Sleuth* aren't necessarily meant for every PC user inside the company. They're best left in the hands of the power users. But they do belong.

Call it a tie between these two products: *Check-It* and *System Sleuth* are both sensational. And don't forget about *Manifest*, a similar system analyzer from Quarterdeck that's included with *QEMM-386* 5.0, a memory manager described in the memory diagnostics/memory management section, or \$59.95 by itself. We're also impressed by the new *Control Room* (\$129, Ashton-Tate Corp., (213) 329-8000).

If you're called upon to diagnose hard disks frequently, consider supplementing *Check-It* and *System Sleuth* with *Disk Technician Advanced*, Version 6.0, and *Disk Technician Pro*, (\$149.95 and \$59.95, respectively; Prime Solutions Inc., (619) 274-5000), and *Spin-Rite II* (\$89, Gibson Research Inc., (714) 830-2200).

Check-It, Version 2.1. Touchstone Software, 909 Electric Ave., #207, Seal Beach, CA 90740; (800) 531-0450, (213) 598-7746. **List Price:** \$149. **Requires:** 384K RAM, DOS 2.0 or later. **Last Review:** April 10, 1989, Page 48.

CIRCLE 607 ON READER SERVICE CARD

System Sleuth, Version 2.1. Dariana Technology Group Inc., 7439 La Palma Ave., #278, Buena Park, CA 90620-2698; (714) 994-7400. **List Price:** \$149.

Requires: 256K RAM, DOS 2.1 or later. Not recently reviewed.

CIRCLE 608 ON READER SERVICE CARD

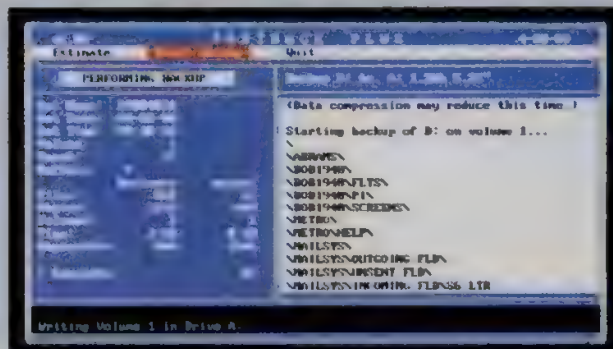


Disk Backup Fastback Plus

Tape drives and networks are the best, most hassle-free methods to back up the data on your PC's hard disk. But there's nothing wrong with floppy disk backup if you can spare a few minutes a day. For years, *Fastback Plus* from Fifth Generation Systems has been the way to make floppy disk backups. It's the best-selling backup utility; the safest, the fastest, and the best.

Options let you automate repetitive backup tasks, make incremental backups, or back up only a subset of your files, such as all .WKS files anywhere on your disk plus everything in your c:\personal directory. You can record a macro and then create a batch file to automate the backup process for less-skilled users.

Fastback isn't limited to floppy disks. You can also back up data to a network drive or a removable drive cartridge. Finally, if you need to take home several dozen files to finish a project, *Fastback* compresses all your files, often onto a single disk, and capably splits large files onto successive disks.



Fifth Generation Systems' *Fastback Plus* (\$189) provides fast, safe, and accurate backups from your PC to floppy disks. With *Fastback Plus*, you can compress 2MB or more onto a single floppy disk.

Three other backup programs to consider: Central Point Software's ubiquitous *PC Tools* (latest version, *PC Tools Deluxe* 6.0), which includes backup as one of its many tools; *DMS/Intelligent Backup*, Version 3.2, remarkably easy to use if not especially fast (\$149.95, Sterling Software Inc., (714) 889-0226); and the new *Norton Backup* 1.1 (\$149, Peter Norton Computing, (800) 624-8999, (213) 319-2010), which looks like a worthy competitor for *Fastback Plus* and is faster in many cases.

Fastback Plus, Version 2.10. Fifth Generation Systems Inc., 10049 N. Reiger Rd., Baton Rouge, LA 70809; (800) 873-4384, (504) 291-7221. **List Price:** \$189.

Requires: 335K RAM, DOS 2.1 or later.

Last Reviews: January 16, 1990, page 162; August 1989, page 294.

CIRCLE 546 ON READER SERVICE CARD

Disk Caches Super PC-Kwik

Faster and newer processors aren't the only way to speed up your PC. Disk caches provide large amounts of performance bang for the buck. A disk cache works this way: on the very likely chance that the next chunks of data you'll want to read are near the data you just read, or the very same data, a disk cache buffers that information into memory reserved by the cache. In the past year or two, disk caches have overtaken RAM disks as the best way to use extra memory. The more memory you can set aside for a cache, the better. You'll see benefits from a 256K cache; you should try to reserve 1MB and, if you can, set aside 2MB. That's why it's smart to outfit a new PC with 4MB of system memory: 1MB for DOS, 1- to 2MB for the cache, and 1- to 2MB for expanded memory, a RAM disk, print spooler, or additional program space if you're running a multitasking environment such as *Microsoft Windows* or *DESQview* 386.

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UTILITIES THE 33 BEST

Our favorite software cache is *Super PC-Kwik* disk accelerator from Multisoft, the Editors' Choice from our last in-depth review of caches ("Getting the Most Out of Memory," *PC Magazine*, February 14, 1989, page 186). It's quick, it's safe, and it works. There's a hands-off installation that correctly installs *Super PC-Kwik* for most users, although you probably should fine-tune the parameters for best results. In its default mode, *Super PC-Kwik* often decides that the right amount of memory it should grab for the cache is: everything it can lay its hands on. You can also get *Super PC-Kwik* in Multisoft's \$129.95 *PC-Kwik Power Pak 1.54*, which adds a print spooler, RAM disk, keyboard accelerator, and screen accelerator. Of these utilities, *Super PC-Kwik* is the one standout.

You'll find *Super PC-Kwik* already bundled on many new PCs. Those that don't have *Super PC-Kwik* typically have some other cache included. Virtually any cache is better than no cache at all; there's far less difference among caches than there is between cache and no cache. We're also partial to *Flash*, Version 7.04 (\$69.95, Software Matters, (800) 253-5274; (317) 253-8088), which is a bit quicker than *Super PC-Kwik* on some reads, while *Super PC-Kwik* wins on file creation tasks. If you've got *Microsoft Windows*, you've got *SmartDrive* (SMARTDRV.SYS), a lower-performance cache with one nice feature: if your PC has limited system memory and *SmartDrive* is loaded into expanded memory, *SmartDrive* loans some of the memory back to *Windows* if *Windows* temporarily runs short.

Three footnotes on caching: First, don't confuse disk caches with memory caches. Software caches buffer information headed into and out of your hard disk; the memory cache does the same for data going between your CPU and system memory. 80386 PCs typically come with a memory cache controller. Unlike a disk cache, you can't add a memory cache after the fact. Second, PC Labs tests indicate that 2MB software disk caches equal or outperform more-expensive replacement hard disk controllers with caches built-in (see "Caching Controllers: Hard Disk Access in No Time Flat," *PC Magazine*, June 12, 1990.) Last, if you install a disk cache, you may be able to cut down or eliminate the BUFFERS= statement in your CONFIG.SYS file from the 20 or 30 recommended. Each buffer takes 528 bytes; eliminating or reducing them frees 10- to 15K of memory in your 640K DOS space.

Super PC-Kwik, Version 3.5. Multisoft Corp., 15100 SW Koll Pkwy., Beaverton, OR 97006; (800) 627-5945, (503) 644-5644. **List Price:** \$79.95. **Requires:** 10K RAM, DOS 2.0 or later. **Last Review:** February 14, 1989, page 186.

CIRCLE 547 ON READER SERVICE CARD

Disk Compression

PKZIP

Like popcorn, many files are more air than anything else. Compression, or archiving, programs take the air out of files you won't need immediately. You can further save disk space by ganging many small files under one archived file, which saves the 4K overhead that DOS imposes per file regardless of file size. Compared to their

Moreover, not every program can read every other program's archive format, so you want whatever is the standard. *PKZIP* (and *PKUNZIP*) from Phillip Katz has become that standard, effectively supplanting *ARC* from System Enhancement Associates. *ARC* lost out when Katz wrote a better *ARC* derivative program called *PKARC* and wound up in a legal battle with SEA's *ARC*. A pox on all your *ARC* houses, many users decided, and switched to Katz' *ZIP* program instead. *PKZIP* also won favor among developers who compress program files because there's no royalty beyond the initial fee for the program.

PKZIP, Version 1.1, lets you create a self-extracting file, meaning that the user just types the name of the archived file, and it automatically restores itself to its original state. If you plan to create a lot of



Archive programs compress your data files to as little as 10 percent their original size. The current standard is *PKZIP* and *PKUNZIP*, sold by PKWARE for \$47 each with a free trial if you download them from a bulletin board.

original file sizes, archived word processor files typically take up half the space; graphics files, as little as a tenth. Even program files can be squeezed by a third or more. Results, obviously, vary greatly from file to file and depend on which compression program you use. Get a bunch of hackers on a bulletin board and they'll argue themselves to death over which of the dozens of programs yields 1 percent more compression than another. In this case, who wins? Most likely the long-distance carriers.

Most arc/dearc programs work adequately, though few are easy to use because most work from the command line rather than a menu. For instance, here's how you run one of our favorite archiving programs:

```
LHARC [<command>] [{/|-}<switch>[-
|+|2|<option>]] . . . ]<arc-
hive_name> [{<drivename>:}<home
directoryname> \}] [<pathname> : . . ]
```

self-extracting files, however, choose *LHARC* 1.13c, a free but copyrighted utility by Haruyasu Yoshizaki (Yoshi), whose self-extractor is more compact than *PKZIP*'s: 2K vs. 10K. It's on PC MagNet, CompuServe, and many bulletin boards as LH113C.EXE.

PKZIP, Version 1.1; **PKUNZIP**, Version 1.1. PKWARE Inc., 7545 N. Port Washington Rd., Glendale, WI 53217; (414) 352-3670. **List Price:** \$47; also available as shareware on bulletin boards. **Requires:** 128K RAM, DOS 2.0 or later. Not recently reviewed.

CIRCLE 548 ON READER SERVICE CARD

Disk Optimization

FastTrax

Your hard disk reads files fastest when the file is located on the same or adjacent disk tracks. As the disk fills, the files become fragmented, and performance degrades as your drive's read/write heads jumps from track to track finding and reading the data.

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Microsoft Word, Microsoft Excel and Ventura. And we give you extensive import/export options to make file transfer a breeze.

CorelDRAW is value-packed...we bundle in over 100 free typefaces and over 6 megabytes of clipart and provide you with access to over 4500 additional typefaces from industry leaders such as Adobe, Bitstream, Compugraphic and others. Also included is a free PANTONE license and over \$2500 of valuable coupons.

We make it easy for you. You can be up and running in minutes - and for



Disk optimizing, or defragmenting, programs return your disk to peak performance. A less-frequent and more-important benefit is that if you accidentally delete a large file or if the disk suffers damage, file recovery is easier and likely to be more complete if your file segments are contiguous.

Two caveats: First, the performance gains with disk optimizers are fractional compared, say, with what you'll see by adding a disk cache. Second, just about every DOS tools program (*Norton*, *Mace*, *PC Tools*) now builds in a disk defragger, and the performance gains of a standalone disk optimization program are even more fractional. That said, we do have a favorite: *FastTrax*, \$59.95 from Bridgeway Publishing Corp. It does a neater, quicker, tighter job than most programs because of its unique optimization routines. *FastTrax* arranges files so that, wherever possible, each file is stored on just one cylinder (a cylinder is the set of all tracks on all disk platters that are same distance out from the center).

FastTrax, Version 3.91. Bridgeway Publishing Corp., 2165 E. Francisco Blvd., San Rafael, CA 94901; (415) 485-0948. **List Price:** \$59.95. **Requires:** 192K RAM, DOS 2.0 or later. **Last Review:** October 11, 1988, page 187.

CIRCLE 549 ON READER SERVICE CARD

Virus Protection

Scan, Cleanup

During the surge of publicity surrounding computer viruses in 1989, the popular press likened computer viruses to human AIDS and came up with many of the same warnings: Know whom you're dealing with, you can't be too safe, don't exchange disks with strangers, abstain, etc. Truth is, viruses are a) immensely scary, and b) blown all out of proportion. The evil that men do to computers is far more often the result of dumb mistakes by users themselves, power failures (especially if the lights go out while you're writing data to disk), and wear and tear on equipment. Unfortunately, that doesn't make for such dramatic headlines.

Because the chance that you'll be attacked by a virus is so small, it's not worth the memory overhead of keeping a TSR virus-watcher loaded and active in the background, especially since no one program detects all viruses. The product we admire most is *Scan* by McAfee Associates. If you fear you've been hit by a virus, run *Scan* to see if your program files have been tam-

pered with, then run *Cleanup* to salvage them. The *Scan/Cleanup* combination usually recovers the bulk of your files; a handful may be damaged beyond recovery and you'll have to reload backup versions. Run *Scan* for a few days afterward to make sure there's no rearguard guerilla action that was missed in the first sweep.

You might also consider *Flu Shot*, Version 1.7, a \$14 shareware program available on bulletin boards (Software Concepts Design (212) 889-6431).

Scan, Version 61; **Cleanup**, Version 61.

McAfee Associates, 4423 Cheeney, Santa Clara, CA 95054; (408) 988-3832. **List Price:** *Scan*, \$25; *Cleanup*, \$35.

Requires: 256K RAM, DOS 2.0 or later. Not recently reviewed.

CIRCLE 550 ON READER SERVICE CARD



Command Line Utilities

List CED, PCED

Too often, the shareware and public domain utilities you run on the DOS command line are written for and by hackers who believe menus are for wimps and who gag at the sight of a graphical interface. They're worried that if PCs get too easy to use, why, gosh, everyone would use them.

Two command-line utilities *anyone* can use are *List*, a file browser, and *CED*, a command-line recaller.

Written by Vernon D. Bueg, *List*, Version 7.3, acts like an intelligent DOS TYPE command. Instead of typing TYPE FILENAME, you type LIST FILENAME and the file pops up on screen but doesn't scroll madly away. Instead, *List* waits for you press the Down Arrow to see more of the file or the Up Arrow to see the beginning. It can suppress high-order characters; for instance, the ending characters of every word in a *WordStar* file. Over the years *List* has gained features, most recently a phone dialer, but it's still a classic—and a classic example of the features DOS *should* have built in.

CED (Command Editor) lets you reuse

previous commands simply by pressing the Up Arrow key. Want to recall and modify the COPY C:\BIN*.EXE A:\BIN\BACKUPS command you issued three commands back, and this time to copy all your COM files to the A: drive? Just hit the Up Arrow three times, then use the Right Arrow to slide the cursor to .EXE and overtype with .COM. (Or, you can just type COPY and CED pulls in the most recent command line with COPY on it.) CED has other tricks, like synonyms. Type CED SYN D DIR, and CED knows that the next time you type D all by itself it should pass the command DIR along to DOS. CED is also available for \$35.

You'll find *List* and *CED* on virtually every bulletin board and electronic information service. If you try *CED* and like it, you'll probably want the enhanced version, *PCED 2.0 (Professional CED)*.

List, Version 7.3. Vernon D. Bueg, 139 White Oak Circle, Petaluma, CA 94952; (707) 778-1811. **List Price:** Free for personal use; \$20 payment suggested. **Requires:** 64K RAM, DOS 2.0 or later. Not recently reviewed.

CIRCLE 415 ON READER SERVICE CARD

CED; PCED, Version 2.0. The Cove Software Group, P.O. Box 1072, Columbia, MD 21044; (301) 992-9371. **List Price:** *PCED*, \$53 (*CED* available on bulletin boards). **Requires:** 30K RAM, DOS 2.0 or later. **Last Review:** June 12, 1990, page 44.

CIRCLE 416 ON READER SERVICE CARD

DOS Shells

PC Tools Deluxe

"DOS shell" and "DOS menuing system" sound alike, especially since many products do a bit of both. A DOS shell insulates the user from DOS, supplying easier, alternative ways to issue DOS commands and navigate the DOS directory structure. A menuing system furnishes the user with a menu for starting commonly used programs and often for issuing common commands (COPY, FORMAT), thus usurping a bit of the turf of a DOS shell.

In our last issue we examined DOS shells. To summarize the Editor's Choices, *PC Tools Deluxe*, Version 6.0, is the best product overall. We like *Power Panel* for less-skilled users, *Direct-Tree Plus* and *XTree Pro Gold* for power users. Our reviewers were also impressed with *The Norton Commander*, which is primarily a DOS shell with bells and whistles, such as an automated MCI Mail fetcher and laptop-to-desktop file-transfer facility;

we also like its screen blanker, which looks like a cross between flickering fireflies and the stars in the heavens. You can read about them all in "Playing the DOS Shell Game," *PC Magazine*, June 12, 1990.

For file maintenance alone, you should consider Michael J. Mefford's RN and DR utility programs that appeared in *PC Magazine* (see Edward Mendelson's sidebar for details), or DIRMAGIC, a follow-on variant to RN/DR that Mefford produced for *PC/Computing*, *PC Magazine*'s sister publication.

If you're interested in launching applications from a menu rather than issuing DOS commands, consider one of these DOS menuing programs: *PowerMenu* (\$89.95, Brown Bag Software, (800) 523-0764); *AutoMenu*, Version 4.5 (\$70, Mague Enterprises Inc., (800) 662-4330, (404) 446-6611); *Direct Access*, Version 4.5 (\$90, Delta Technology, (800) 242-6368, (715) 832-7575). Among people who use menus, *AutoMenu* is something of a standard. *PowerMenu* is a crossover between DOS shell and menuing programs, adding a nice security feature and mouse support. Given the low prices of

UTILITIES THE 33 BEST

menuing software, it's crazy to have anyone in a company ever again waste his or her time creating, for less-skilled users, a "Type 1 to word-process, Type 2 for Lotus, Type 3 to format floppy disk" batch file ever again.

We suspect the days are numbered for many of the lesser menuing programs with the advent of *Microsoft Windows 3.0*, which provides a strong dose of ease of use, although it's still not on par with the Macintosh.

DOS Tools

**The Mace Utilities
The Norton Utilities,
Advanced Edition
PC Tools Deluxe**

As we said in the introduction, one or more of these three utilities should be the cornerstone of your DOS utilities software shelf. They're well-known; you can read about them in detail in "Disaster Relief: DOS Utilities Save the Day," *PC Magazine*, March 27, 1990, page 97. They provide file and directory undeletion, visual trees, disk testing and error correction, and file

finding. You'll want *PC Tools Deluxe* for its range and ease of use, *The Mace Utilities* for heavy-duty disaster recovery, and *The Norton Utilities, Advanced Edition*, for general disk maintenance.

The Mace Utilities, Version 1990. Fifth Generation Systems, 10049 N. Reiger Rd., Baton Rouge, LA 70809; (800) 873-4384, (504) 291-7221. **List Price:** \$149.

Requires: 256K RAM, DOS 2.0 or later.

Last Reviews: March 27, 1990, page 102; March 13, 1990, page 43.

CIRCLE 417 ON READER SERVICE CARD

The Norton Utilities, Advanced Edition, Version 4.5. Peter Norton Computing, 100 Wilshire Blvd., 9th Floor, Santa Monica, CA 90401; (800) 624-8999, (213) 319-2010. **List Price:** \$150. **Requires:** 256K RAM, DOS 2.0 or later. **Last Review:** March 27, 1990, page 107.

CIRCLE 418 ON READER SERVICE CARD

PC Tools Deluxe, Version 6.0. Central Point Software, 15220 N.W. Greenbriar Pkwy., #200, Beaverton, OR 97006; (503) 690-8090. **List Price:** \$129. **Requires:** 512K RAM, DOS 3.0 or later. **Last Reviews:** March 27, 1990, page 112; January 16, 1990, page 171.

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Top of the Line Quality at a Value Price

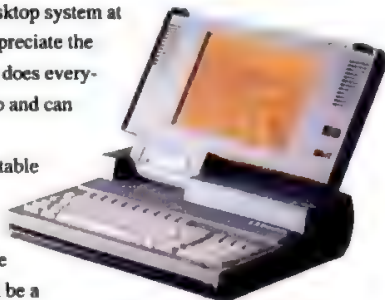
When you are away from the desktop system at your home or office, you will appreciate the features of the **LT5400** laptop. It does everything a desktop computer can do and can also link with a modem.

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	TOPPCs LT5400	COMPAQ SLT286	NEC 386 ProSpeed CSX	TOSHIBA T3200SX	ZENITH Super Sport SX
CPU	80386SX-16	80C286-12	80386SX-16	80386SX-16	80386SX-16
RAM(STD/MAX)	1/4 MB	640 KB/3.6 MB	2/4 MB	1/13 MB	1/8 MB
DISPLAY	Gas Plasma/VGA	LCD/VGA	LCD/VGA	Gas Plasma/VGA	LCD/VGA
RESOLUTION	640*480	640*480	640*400	640*480	640*480
KEYBOARD KEYS	85 (detachable)	81	89	91	79
KB/KEYPAD PORT	Yes	Yes	N/A	Yes	Yes
3.5" FDD	1.44 MB	1.44 MB	1.44 MB	1.44 MB	1.44 MB
HDD	40 MB	40 MB	40 MB	40 MB	40 MB
SERIAL PORT	2	1	1	2	1
PARALLEL PORT	1	1	1	1	1
VGA PORT	Yes	Yes	Yes	Yes	Yes
EXT-FDD PORT	5.25"	5.25"	5.25"	5.25"	5.25"
I/O EXP-SLOT	2	2	2	(6)	3
SIMULTANEOUS INT/EXT DISPLAY	Yes	No	No	Yes	No
SEPARATE FDD/PRINTER PORTS	Yes	No	No	No	No
WARRANTY	18 Months	12 Months	12 Months	12 Months	12 Months
LIST PRICE	\$5,000	\$5,999	\$6,499	\$6,299	\$6,799

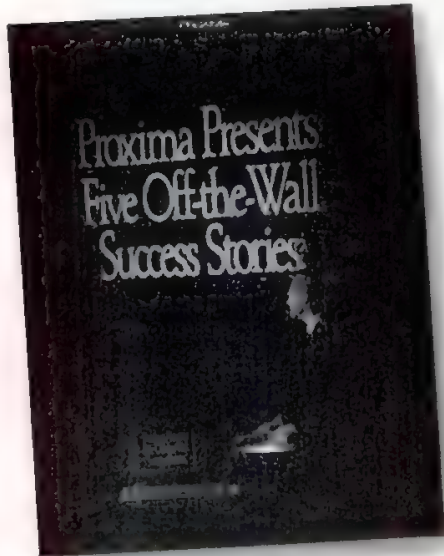
Our distributors across the United States:

- AZ: TRANSOURCE, (602)997-8101
- CA: Mini Micro, (408)434-8859 / Polywell, (415)583-7222 / System Avenue, (213)926-9849
Diamond Tech, (714)252-1008 / Nimax, (619)566-4800
- CO: World Network, (303)592-5890
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- GA: National Micro, (404)446-0520
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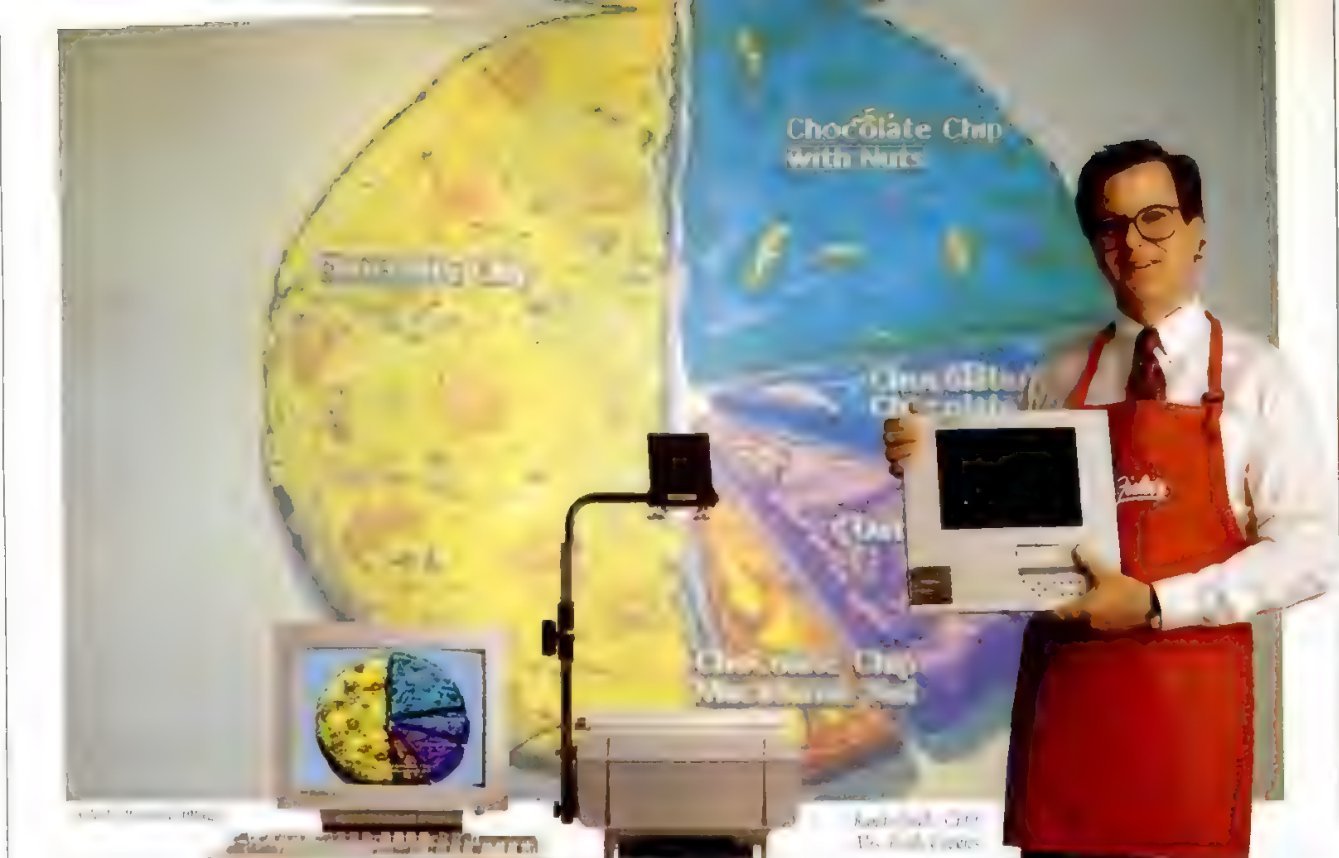
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UTILITIES THE 33 BEST



GRAPHICS

Screen Capture

Hot Shot Graphics Pizazz Plus

Screen capture and graphics conversion categories embrace many of the same products. Screen capture programs take a snapshot of your screen image and save it to disk, either as a commonly used file format such as .PCX or .TIF, or in some cases a proprietary format. If you're planning to publish screen images, whether for an in-house training guide or for a glossy magazine as we do, you'll want to take electronic images, not traditional photographs. It's cheaper and it's better, because the image always comes out with square corners and straight edges, something that's almost impossible with a traditional camera. Screen images also can be replayed as slide shows by programs like Software Publishing Corp.'s *Harvard Graphics* or Bright-

bill-Roberts's *Show Partner*.

All five products reviewed recently ("Hold It! Screen-Capture Software Saves the Moment," *PC Magazine*, April 24, 1990) do a capable job: *Collage Plus*, *The Graphics Link Plus*, *HiJaak Plus*, *Hot Shot Graphics*, and *Pizazz Plus*. *Hot Shot Graphics* and *Pizazz Plus* are the best. *Hot Shot Graphics* does the best job of annotating images, adding borders, arrows, and titles, and there's a capable bit-level editor to fine-tune rough edges (making these products a bit like paint programs, too). *Pizazz Plus* provides the most sophisticated mapping of screen colors to black-and-white printed output.

At *PC Magazine*, we've settled on *Collage Plus*, Version 3.0 (\$89.95, \$199 for OS/2; Inner Media Inc., (603) 465-3216) for producing the screen images you see in print. We're willing to put up with its occasional crashes and lack of editing tools because it captures so many graphics screens (including 256-color) and saves them in so many file formats (19).

Hot Shot Graphics, Version 1.6. Symsoft Inc., 924 Incline Way, Callbox 5, Incline

Village, NV 89450; (702) 832-4300. **List Price:** \$249. **Requires:** 512K RAM, DOS 2.1 or later. **Last Review:** April 24, 1990, page 264.

CIRCLE 420 ON READER SERVICE CARD

Pizazz Plus, Version 1.3, Application Techniques Inc., 10 Lomar Park Dr., Pepperell, MA 01463; (800) 433-5201, (508) 433-5201. **List Price:** \$149.

Requires: 85K RAM, DOS 2.1 or later. **Last Review:** April 24, 1990, page 268.

CIRCLE 421 ON READER SERVICE CARD

Graphics Conversion

The Graphics Link Plus

Most screen-capture programs also translate among file formats. *The Graphics Link Plus*, \$149 from HSC Software, does it best. Its interface may be nonstandard and confusing at first, but it translates files correctly. There's also a batch process, not so important if you're using this as a once-a-month utility, but crucial if you're a graphics or publishing professional.

By graphics conversion we mean the ability to convert among bitmap, or raster, image formats, such as .PCX or .TIF. If you want to convert among the vector formats used by CAD and drawing/design

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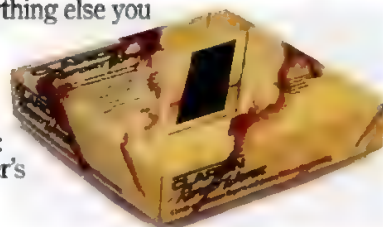
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programs, virtually the only program available now is Micrografx's *Xport* (\$395, Micrografx Inc., (800) 272-3729, (214) 234-1769). Despite speed and reliability problems, *Xport* has been more versatile than the conversion programs built into various draw/design programs.

To convert a bitmap image to a vector image, you want an auto-trace program. Vector images take up less room on disk than bitmaps, and the image quality is unaffected by image size. Again, most draw and design software has an auto-trace utility. Slightly better than the built-ins is *Streamline* (\$395, Adobe Systems Inc., (800) 344-8335, (415) 961-4400).

The Graphics Link Plus, Version 2.0. HSC Software, 1661 Lincoln Blvd., #100, Santa Monica, CA 90404; (213) 392-8441. **List Price:** \$149. **Requires:** 512K RAM, DOS 3.1 or later. **Last Review:** April 24, 1990, page 258 (as screen capture software).

CIRCLE 422 ON READER SERVICE CARD



Keyboard Macros

Keyworks Advanced

Keyboard macro programs were one of the first utility categories for the PC. Products such as RoseSoft's now-faded *ProKey* and Borland's *SuperKey* recorded keystrokes as you typed them, then played them back later with the press of an Alt or Ctrl key. All let you pause to insert a fixed or variable number of keystrokes—for instance, a filename—and all were markedly easier to understand than the crude *Lotus 1-2-3* macro facility. Now, many major programs have built-in macro recorders. Still, there are times when you'll need a third-party program. The best of the survivors is *Keyworks Advanced* from Alpha Software. It's the most robust product of its kind. What makes it stand out is freedom of conflicts from other TSRs, the ability to create your menu of macros for other users, and the ability to back up and make a macro out of keystrokes you've already typed in. Use *Keyworks Advanced* if your program lacks a macro facility or it's not powerful enough. If you don't need all the conditional branching and looping, a cheaper, detuned version, *Keyworks 3.0*, is also available.

Keyworks Advanced; Keyworks, Version 3.0. Alpha Software Corp., One North Ave., Burlington, MA 01803; (617) 229-2924.

List Price: *Keyworks Advanced*, \$175; *Keyworks 3.0*, \$99. **Requires:** 128K RAM (64K RAM with EMS), DOS 2.0 or later. Not recently reviewed.

CIRCLE 423 ON READER SERVICE CARD

Keyboard Speedup

TYPEFAST

If public domain and shareware screen dimmers seem to be prevalent, they're positively scarce compared to the variety of keyboard speedup programs available for free, for a shareware contribution, or for sale. We're partial to TYPEFAST and TPFAT-AT, free utilities created for *PC Magazine* by contributing editor Michael J. Mefford (see Utilities, *PC Magazine*, April 24, 1990, page 287). TYPEFAST resets your keyboard's typematic rate (how fast a key repeats when you hold it down) and initial delay (how long until typematic kicks in). TYPEFAST supplants earlier *PC Magazine* speedup utilities, QUICKEYS for 8088/8086 PCs and SPEEDUP for 286 and 386 PCs.

Also check the utilities you already own. More than a few include a keyboard speedup utility. If you're inclined to buy a standalone utility, the best-known and most readily available is *Cruise Control*, Version 3.02, (\$59.95, Revolution Software, (201) 455-0995).



Print Spoolers

PrintCache

Your PC can format a long file and kick it out to the printer in seconds, but the printer may need minutes for the actual printing. Enter the print spooler, which takes the data from your PC (and gives you back control of the PC), then spoonfeeds the data in manageable chunks to the printer in the manner prescribed by Karl Marx: from each according to his abilities, to each according to his needs.

There are three kinds of print spoolers, or printer buffers: those built into the printer

(often small and good for just a handful of pages), external devices the size and shape of modems (cheap to build, they were tremendous cash cows in the late 1980s for companies such as Quadram), and software-based spooler programs. The last category is the cheapest and most effective. Software spoolers use expanded or extended memory if available; they can use free hard disk space or memory in the first 640K if not. *PrintCache*, Version 2.2, from LaserTools is the best of the bunch. *PrintCache* is the evolution of a laser-printers-only product formerly and more memorably called *LaserTorq*. *PrintCache* works with laser printers, PostScript laser printers, plotters and dot matrix printers; it's compatible with *Windows/286* and *Windows/386*—and substantially faster than the *Windows/286* spooler. Optimizing routines make *PrintCache* especially fast when printing to slow serial ports.

Print spoolers are especially important when several users share one printer via an automatic print-sharing device, especially since it seems as if the other guy always chooses to print his 40-page report moments before you send along a single-page memo. You won't get the memo printed any faster, but at least your PC won't be hung up.

LaserTools also makes a fascinating niche product: *Trading Post*, Version 2.0, a \$99 PostScript print enhancer that lets you print any DOS file on an Apple LaserWriter and most other PostScript printers. *Trading Post* also does graphics screen dumps, but it can't print the IBM high-order character box graphics. If you've got a PostScript and no access to a LaserJet compatible or dot matrix printer, *Trading Post* is a must-have.

PrintCache, Version 2.2. LaserTools Corp., 1250 45th St., #100, Emeryville, CA 94608; (800) 767-8004, (415) 420-8777.

List Price: \$149. **Requires:** 9K RAM, DOS 2.1 or later. **Last Review:** April 10, 1990, page 43.

CIRCLE 425 ON READER SERVICE CARD

Labels

LabelPro

How powerful is your PC if you have to keep a typewriter handy for envelopes and mailing labels? Avery's *LabelPro* takes you one step closer to chucking the Selectric. *LabelPro* knows how to overlay type correctly on 14 styles of Avery-brand laser printer labels that can be used for mass mailings, parcels, nametags, and even overhead transparencies.

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Japan	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Other	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
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ANALYSIS & FORECASTS

	1988	1989	1990	1991	1992
United States	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Europe	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Japan	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Other	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
TOTAL	4,000.0	4,000.0	4,000.0	4,000.0	4,000.0

STOCK PRICES

	1988	1989	1990	1991	1992
United States	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Europe	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Japan	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Other	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
TOTAL	4,000.0	4,000.0	4,000.0	4,000.0	4,000.0

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Allways and 1-2-3 Rel 2.0, 2.01, & 2.2 Compatibility

PC PUBLISHING IMPRESS is compatible with Allways files. So you can improve them, or simply work on them without having to toggle to text mode. IMPRESS works with 1-2-3 Rel 2.0, 2.01, & 2.2.

Technical Requirements

IMPRESS works with: 1-2-3 release 2.0, 2.01 or 2.2, DOS 2.0 or later, CGA, EGA, VGA or Hercules (No color in CGA). Supports all graphics printers that work with 1-2-3: including Dot Matrix, Desk Jet, Laser printers (Hewlett Packard, Postscript, etc.). Color printers. IMPRESS occupies 93k RAM above 1-2-3 (uses EMS if available). Many Bitstream Fonts included with package. 1-2-3 is a registered trademark of Lotus Development Corp.

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PC PUBLISHING IMPRESS is officially recommended by Lotus Development Corporation, and Lotus is incorporating the Impress Technology into its future 1-2-3 Release 3.1.

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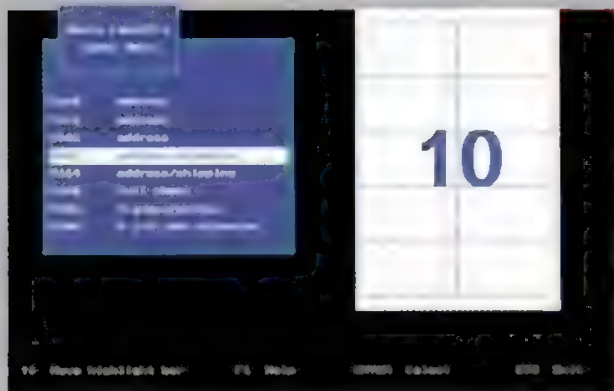
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The interface of Avery's *LabelPro* would benefit from a redesign (not every screen is as clear as the label menu above), but at \$99.95, this is just the ticket to print mailing labels and nametags. You can import from the built-in database or from your own.

Shades of give-away-the-razors, sell-razor-blades? Not quite, since the razor here costs \$99.95 list. It does include a pair of scalable, downloadable fonts (Times Roman and Helvetica replicas), a built-in names-and-lists data manager, and an import facility for external data. The interface is clunky and could benefit from mouse support; less-skilled users who don't have a clue as to what well-designed software looks like will find *LabelPro* easier to pick up than power users.

Plan to buy Avery-brand laser-printer labels to keep *LabelPro* up and running. You can't customize *LabelPro* for other labels, not even Avery's photocopier labels (slightly different layouts). Avery says that's for your own protection. Laser labels use a special, stickier adhesive that supposedly keeps labels attached as they curve through your printer.

Before you spring for a label program, check to see if your high-end word processor has the ability to print label sheets. Microsoft's *Word for Windows* and WordPerfect Corp.'s *WordPerfect* do. An even greater number of word processors now can print envelopes in laser and dot matrix printers, directly or with macros. *PC Magazine* wrote envelope macros for a half-dozen major word processors; they're available free on PC MagNet. If you want to print directly on envelopes, you can also find a number of commercial utilities as well.

LabelPro. Avery Commercial Products Division, 818 Oak Park Rd., Covina, CA 91724; (819) 915-3851. **List Price:** \$99.95. **Requires:** 512K RAM, laser printer. **Last Review:** February 13, 1990, page 51.

CIRCLE 426 ON READER SERVICE CARD



Screen Enhancers

UltraVision

What if you don't like the screen font supplied with your PC, or you want more columns and rows than the industry-standard 25 and 80? Your best bet is *UltraVision*, Version 2.0, from Personics, which gives you 20 screen fonts to choose from and as many as 20 different combinations of rows and columns. A handful of the fonts are gimmicks (do you really want an Olde English display?), but most users will find one of the fonts more to their liking than the fixed font supplied by their graphics adapter. You can also customize screen colors. Compared with all the free, shareware, and commercial utilities that appear to compete, *UltraVision* has two advantages: it does more, and it's become something of a standard. Many programs, such as *WordPerfect* and Lotus's *Magellan*, automatically adapt to *UltraVision* displays, and *UltraVision* supplies drivers for popular programs that don't automatically adapt. Previous versions worked with EGA only; the new version works with EGA and VGA.

If you're annoyed by the size, shape, and blink rate of your cursor, consider two specialty products that do just what their names imply. *NoBlink/Accelerator*, Version 5.3 (\$49.95, Nostradamus Inc., (800) 388-8086; (801) 272-0671), adjusts (or eliminates) the blink rate and speeds up the

cursor. *No-Squint Laptop Cursor* (\$39.95, SkiSoft Publishing, (617) 863-1876) enlarges the cursor so that it's visible on the dimmest of laptop portable displays.

Two hardware tips: graphics cards, not the PC or monitor, determine what your text font looks like on-screen. You'll be staring at it for the next five years, so look before you buy. Also, some vendors are beginning to offer a nonblinking cursor that you can invoke by setting a DIP switch.

UltraVision, Version 2.0, Personics Corp., 63 Great Rd., Maynard, MA 01754; (508) 897-1575. **List Price:** \$119.95. **Requires:** 19K RAM, EGA or VGA display, multiscanning monitor to display 640 by 480 pixels with EGA card. **Last Review:** May 29, 1990, page 48.

CIRCLE 611 ON READER SERVICE CARD

Screen Blankers

VGA Dimmer

Before 1985, users worried about things like:

- "Are my floppy disks vulnerable to dust and should I buy dust covers for them?" (as if falling dust made a right-angle turn upon spotting an unprotected floppy disk).
- "How much can I save with a ribbon re-inker?"
- "If I leave my display on too long, will the phosphors wear out?"

Question #1 faded, question #2 evolved into the toner-refill issue, and question #3 has split into two facets: monitor longevity and low-level security.

We don't believe that monitors benefit greatly from being dimmed when you're away at lunch, but if you insist, there are a bunch of screen-dimmer utilities available, commercially as well as on bulletin boards for free or for a shareware contribution. They're no longer dangerous (some early utilities intended for color displays smoked monochrome monitors). Our favorite is *VGA Dimmer*, \$29.95 from Revolution Software. One nice feature is a hotkey that lets you blank the screen *right now* if someone walks up behind you while you're working on a confidential or personal document. If you navigate bulletin boards, look for *Burnout*, a free program by Chris Dunford. It, too, has a panic key that instantly blanks your screen.

Because this article was written during the transition from *Windows/286* to *Windows 3*, we've steered away from *Windows* utilities. However, we've been mightily impressed by the screen-blanker abilities of the *Windows Workstation LAN*

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UTILITIES THE 33 BEST

File 11 of 33

Account	Account Description	VTD	Monthly
1	ALL-SEASONS RECREATION UTILITIES, INCORPORATED		
2	EXPENSES: ALL DEPARTMENTS		
3			
4	Acct. #		
5	Employee Expenses		
6	110 Salaries & Wages	171,465	29,75
7	120 Taxes & Work Comp	46,796	8,03
8	130 Commissions	56,436	9,52
9	140 Retirement Plans	20,576	3,52
10	150 Employee Insurance	9,000	1,50
11	160 Employee Welfare	1,138	52
12	170 Training	1,990	10
13			
14	Outside Services		
15	201 Telemarketing Services	2,616	43

Account	Account Description	VTD	Monthly	Quarterly	Yearly
1	ALL-SEASONS RECREATION UTILITIES, INCORPORATED				
2	EXPENSES: ALL DEPARTMENTS				
3					
4	Acct. #				
5	Employee Expenses				
6	110 Salaries & Wages	171,465	29,75	89,25	1,071,00
7	120 Taxes & Work Comp	46,796	8,03	24,09	289,00
8	130 Commissions	56,436	9,52	28,56	342,00
9	140 Retirement Plans	20,576	3,52	10,56	126,00
10	150 Employee Insurance	9,000	1,50	4,50	54,00
11	160 Employee Welfare	1,138	52	156	1,872
12	170 Training	1,990	10	30	360
13					
14	Outside Services				
15	201 Telemarketing Services	2,616	43	129	1,548
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
TOTAL		479,289	80,114	309,630	3,672,00

UltraVision gives you more-attractive fonts and more characters and lines on your VGA or EGA display. Above, the same VGA screen is shown at 80 by 25 and 108 by 63. You can go as far as 132 by 63—if you've got a note from your eye doctor.

utility (\$695 for ten users, Automated Design Systems, (404) 394-2552). One timer blanks the display and ping-pongs a .PCX file around the screen (often your corporate logo); a second timer requires you to enter a password to restore the screen. That's handy if you think you'll be away from your desk for 5 minutes and find yourself away for 90.

VGA Dimmer, Revolution Software, 320 Route 24, Chester, NJ 07930; (201) 455-0995. **List Price:** \$29.95. **Requires:** 3K RAM. **Last Review:** November 14, 1989, page 27.

CIRCLE 612 ON READER SERVICE CARD

grossly understates its abilities; *GrandView* is one of those products that fits more or less under the umbrella of personal information managers. You can filter the information into views based on who's involved, priorities, and dates (as well as categories of your own choosing), which gives *GrandView* some of the abilities of Lotus's sophisticated (and complicated) *Agenda*.

If your outlining needs are simpler, you may be able to get by with the outlining features built into an increasing number of word processors: Microsoft's *Word for Windows*, WordPerfect Corp.'s *WordPerfect 5.1*, Ashton-Tate's *MultiMate IV*, Software Publishing Corp.'s *OfficeWriter 6.0*, and even low-cost programs such as Spinnaker Software's *Better Working Eight-in-One*. Utilities such as *PC Tools Deluxe 6.0* and Borland's *SideKick Plus* have outlining abilities. The *Word for Windows* outliner shows why graphical interfaces make sense: you can show each outline level in a different color and font, which makes the levels even more clear-

cut; you also can collapse headings level by level and hide text for a macro view of your document.

GrandView, Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; (800) 441-7234 (outside Calif.), (800) 626-8847 (inside Calif.), (408) 253-9600. **List Price:** \$295. **Requires:** 256K RAM, DOS 2.0 or later. Not recently reviewed.

CIRCLE 542 ON READER SERVICE CARD

Text Search Magellan

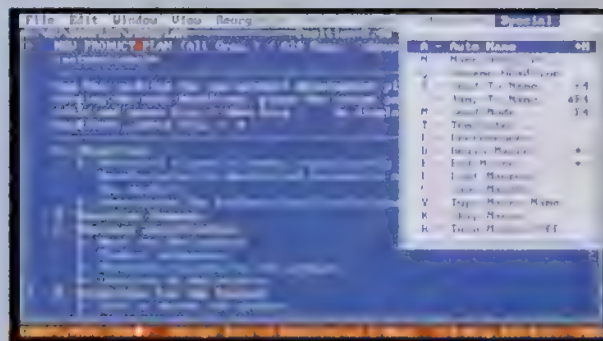
Until *Magellan* came along, text-search programs were clunky, hard to handle, and were used by few people outside of professional researchers and academics. While *Magellan*, Version 2.0, is far more than text search and retrieval, at its core the product resolves this problem: "There's some important data on my disk I have to find, and I know a phrase that would help me locate the file, but I can't locate it. Help!" *Magellan* indexes every single word on your disk and locates any word or phrase in less than 5 or 10 seconds. As in



Outliner GrandView

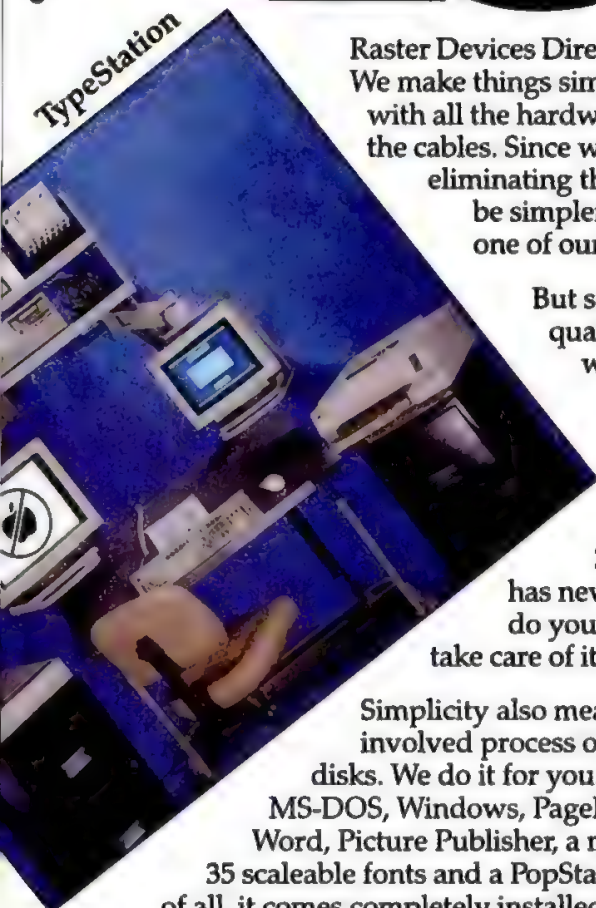
To make large amounts of text information manageable, consider using an outliner. It lets you collapse information into headings and subheadings, then zoom in on the details once you have the big picture. Symantec's *GrandView* is the best of the bunch by a mile. Most outliners produce crude output that looks like, well, an outline; *GrandView*'s sophisticated printer support allows you to produce reports. You can export your *GrandView* information to a word processor, but in most cases you won't need to.

To call *GrandView* just an outliner



A \$295 outliner and personal information manager, *GrandView* provides great output and multiple, filtered views of your information. Some word processors have outliners, but none matches *GrandView*'s robustness.

ASAP



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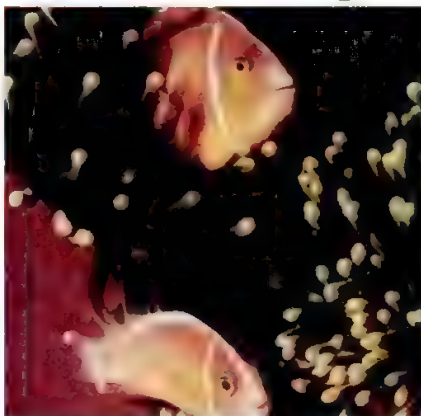
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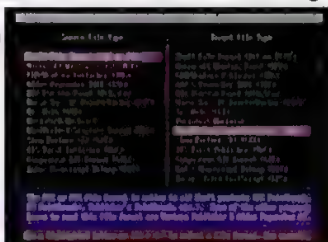
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CIRCLE 502 ON READER SERVICE CARD

UTILITIES

THE 33 BEST

horseshoes, close enough may be good enough: if you think the phrase reads "Tom's red car" and the phrase really is "one of the red cars Tom owns," that's close enough for *Magellan*, which knows about plurals and possessives. With the new version, you can even build a synonym directory that will make a search for "cars" also match on "automobiles;" a Boolean NOT argument lets you search for files containing "automobiles not 'cars'."

Magellan is a labor of love of the Gross brothers, Bill and Larry, who saw Vern Buerger's *List* program for viewing text files from DOS and sought to do the same thing for *Lotus 1-2-3* files. By the time they finished what became *Magellan*, the 1-2-3 browser had evolved into 40 viewers *plus* the ability to load and run the program related to the file you're viewing. If you're viewing a *WordPerfect* file and it needs a handful of changes, two keystrokes loads *WordPerfect* and the file.

Magellan is another one of those Swiss-Army-knife programs that belongs in half a dozen categories. You can use it as a DOS shell to copy, move, and delete files (viewing the contents before deleting, of course). There's file backup and restore, virus detection, undelete, and a menu for launching other programs. *Magellan*'s everyword index adds just 5 to 8 percent disk storage overhead.

Other programs have begun to add viewers (*Norton Commander*, *PC Tools*, Travel Software's *ViewLink*), but *Magellan* is way out front. This is a must-have tool.

Magellan, Version 2.0. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; (800) 343-5414, (617) 577-8500. **List Price:** \$139.

Requires: 512K RAM, hard disk drive, DOS 2.1 or later. **Last Review:** May 29, 1990, page 43.

CIRCLE 543 ON READER SERVICE CARD

Format Conversion

Software Bridge
Word for Word Professional

What if half the office uses one word processor, the other half uses another, and a handful of rugged individuals use niche products such as *Lotus Manuscript* or *Xy-Write III Plus*? To swap files back and forth, you'll need a software conversion utility if your word processor lacks one. The two best are *Software Bridge* from Systems Compatibility Corp. and *Word*

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TurboSetter 1000

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The TurboSetter 1000™ is an IBM PC/XT/AT or '386 compatible laser printer that provides a 1000 x 1000 TurboRes™ output. It comes standard with the Raster Devices 135 scaleable outline fonts especially formatted to match Adobe font widths. The TurboSetter 1000 gives you high quality type and graphics but it doesn't cost you time. In fact, the TurboSetter 1000 images most text pages in 10 to 30 seconds. Compared to PostScript® based systems, it is typically 5-10 times faster even with complex graphics and gray scale images. Higher resolution and faster output makes your job a whole lot simpler and makes your work stand out from all the rest.

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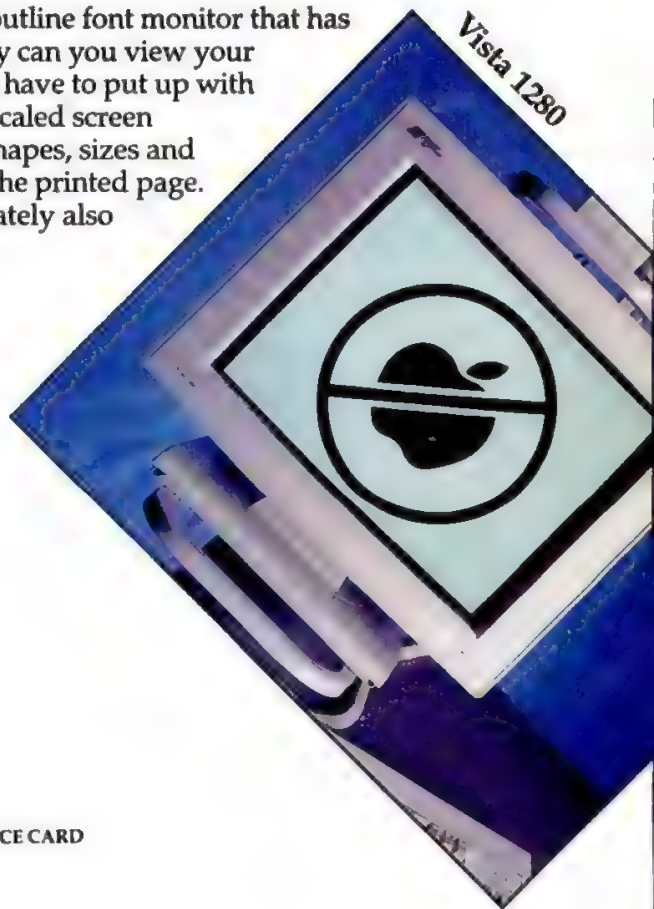
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Vista 1280



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MAN LOSES HAIR WAITING FOR DOS

Anytown, USA—The unidentified victim was apparently among the millions of people who still think that DOS Backup and Copy commands are a safe and convenient way to back up their valuable hard disk data.

It is not known whether the shocking loss was a result of natural aging while DOS made the backup, or whether the victim pulled his hair out in frustration after discovering that a minor disk error had rendered his entire backup set useless.

According to reliable sources, the tragedy could have been averted if the man had been using FASTBACK PLUS, the world's fastest and most reliable backup software.

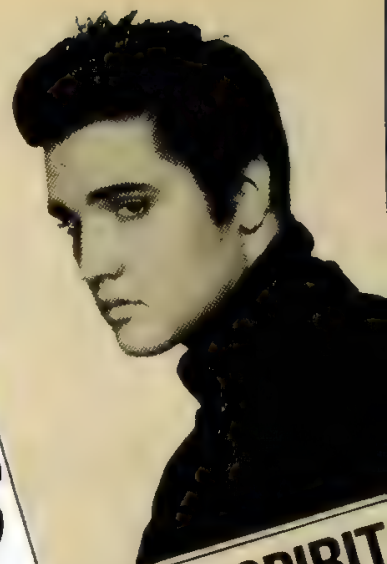
A special commission has been appointed to study ways in which the public can be made aware that FASTBACK PLUS' Advanced Error Correction, easy-to-use menu, flexible file and directory selection, automated backup options and other features allow even beginners to make fast, foolproof backups.

Public knowledge of these facts could ease the wide-spread stress and trauma that result from using DOS commands to back up hard disk data.

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And that's why I'm sure you'll buy **The Brooklyn Bridge**. Because it's the best most complete file transfer program there is. Period.



President and C.E.O. of Fifth Generation Systems, Inc.



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A Name To Remember

UTILITIES THE 33 BEST

Commission Sales - Apr			
	Total Sales	Commission	Bonus
1 Dana Schmidt	36,000	2,600	
2 Brent Hansen	66,500	5,560	
3 Kristin Elliott	34,150	3,415	
4 Todd Watson	51,500	5,150	
5 Michael Blensie	48,050	4,805	
6 Stefan Imel	49,410	4,941	
7 Bob Peterson	49,740	4,974	
8 Cindy Kaiser	54,910	5,491	

Magellan finds any string of text or group of files in less than 5 seconds, then lets you view the matching files in their native modes. Here is a list of all spreadsheet files on the left, with the highlighted Excel file on the right.

for Word Professional from Software Toolworks.

Both are good, but don't expect miracles if you've got really intricate formatting. You've got a better chance of translating boldface and underline than of translating a hanging indent footnote with three nested font changes. Even if they don't translate everything perfectly, you're better off than if you had to swap straight ASCII text files with no formatting whatsoever.

When we last reviewed file conversion programs ("Battling Babel: Word Processing Format Conversion," *PC Magazine*, April 25, 1989), *Software Bridge* was the best of the bunch, with *Word for Word* also acceptable. Note that some programs are stronger at some translating file-format pairs than others, so if you have specific conversion needs, try one copy before you buy for the entire office. Most likely you find the easiest, best conversions are from *Software Bridge*. *Word for Word* is good at converting raw ASCII—

for instance, e-mail messages with hard-carriage returns and the entire document offset by two characters.

Also check if your word processing software includes a translation utility. It may be on a free supplementary disk. If programs can't talk directly, they may be able to communicate via an intermediate file standard, most often DCA, or Document Content Architecture.

Software Bridge, Version 4.1. Systems Compatibility Corp., 401 N. Wabash, #600, Chicago, IL 60611; (800) 333-1395, (312) 329-0700. **List Price:** \$149 (LAN version, \$295); upgrade from previous version, \$49.50. **Requires:** 384K, DOS 2.0 or later. **Last Review:** April 25, 1989, page 144.

CIRCLE 544 ON READER SERVICE CARD

Word for Word Professional, Version 2.0. Software Toolworks, 19808 Nordhoff Place, Chatsworth, CA 91311; (818) 885-9000. **List Price:** \$149; upgrade, \$29.95. **Requires:** 256K RAM, DOS 2.0 or later. **Last Review:** April 25, 1989, page 149.

CIRCLE 545 ON READER SERVICE CARD

OUR CONTRIBUTORS

The utilities included in this article were chosen based on the experiences and recommendations of more than 50 *PC Magazine* editors, contributing editors and frequent contributors. Eight people were heavily involved in the final selection process: Bill Howard and Gus Venditto, the executive editors of *PC Magazine*; Frank J. Derfler, Jr., workgroup systems editor and director of *PC Magazine*'s LAN Labs; Tony Rizzo, senior technical editor of *PC Magazine*; and Edward Mendelson, Robin Raskin, Jim Seymour, and Barry Simon, contributing editors of *PC Magazine*.

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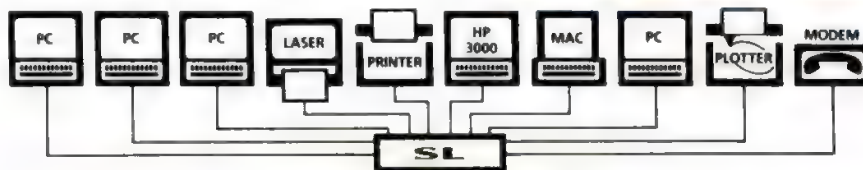
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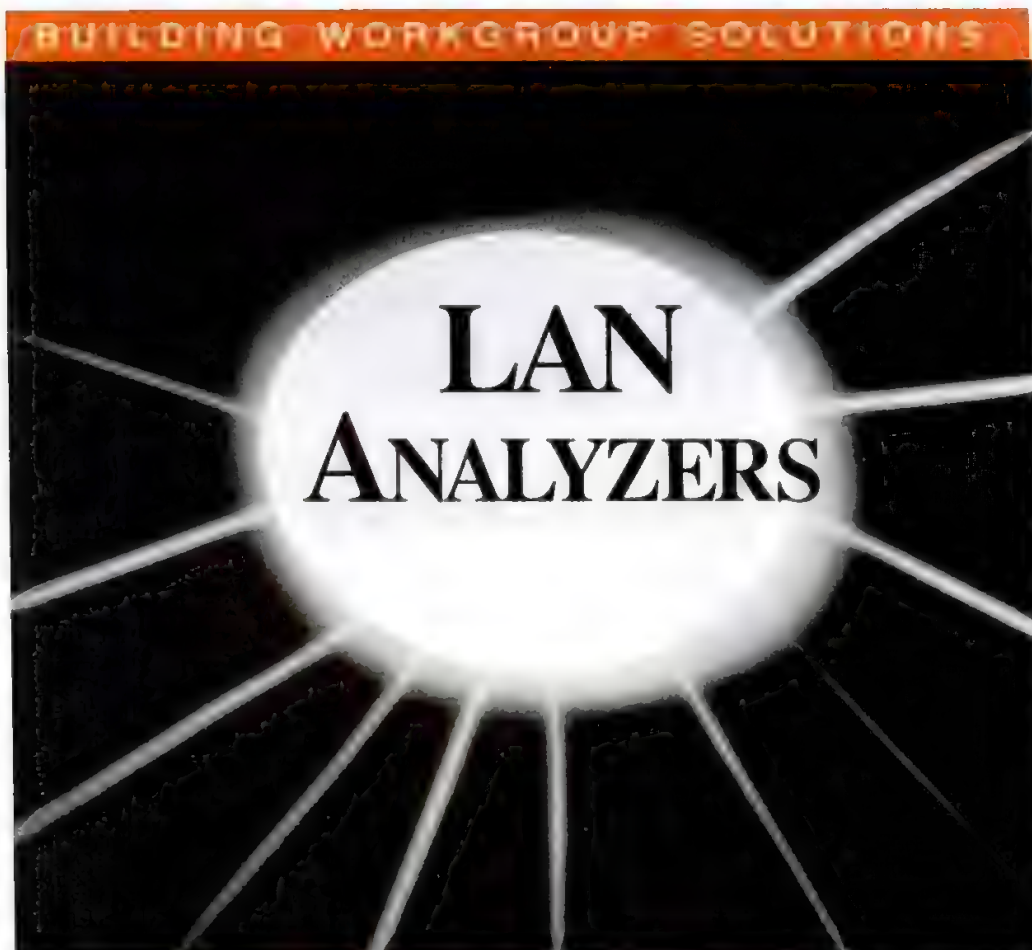


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CIRCLE 241 ON READER SERVICE CARD



Bad packets traveling across a LAN can be a sign of trouble. Protocol analyzers help network administrators spot problems early and identify them.

Traffic counters can't identify packets exactly, but they are less expensive.

BY FRANK J. DERFLER, JR.

“I'm not sure what it does, but I knew when I saw it that I just had to have one.” That feeling, expressed by a fledgling network manager at a Manhattan bank, is shared by many buyers of LAN diagnostic equipment. For some LAN administrators, protocol analyzers provide powerful and essential diagnostic tools. For others, they are talismans and amulets that confer status and possibly ward off network miseries. But with prices up to \$25,000, a protocol analyzer can be a heavy investment for a good-luck charm.

Fortunately, alternative products are more economical and just as useful for typical network managers. The right combination of price and function is worth searching for. To help you find it, we'll start with a few definitions and explanations. First, just what is a protocol and why does it need analysis anyway?

PROTOCOLS UNDER ANALYSIS

A *protocol* is nothing more than a formal agreement about how computers should format and acknowledge information during a communications session. When networking and communications products from different companies follow the same protocol, they have the ability to talk to each other, at least theoretically.

In operation, protocols determine the format of the leading and trailing data blocks in which the communications software wraps the data message. These data blocks form an envelope for the message while it travels through the communications link. Since the sending and receiving systems use the same protocols, they know how to read the envelope's address and then route it, deliver it, and even get a receipt, regardless of the information it contains. If communication over the link breaks down and you need to find the cause of the problem, you can get important clues by reading the leading and trailing blocks attached to a message. You can even open the envelope formed by the blocks and decode the data in the message.

The tool you use to read a protocol-configured packet is called a *protocol analyzer*. Different protocol analyzers exist for all types of communications circuits, including X.25, ISDN, and several types of LAN cabling, signaling, and protocol architectures. You can set up analyzers for Ethernet, ARCnet, and Token-Ring networks. These products typically look like portable or luggable PCs and have screens with flashing displays and software able to produce graphs and printed reports.

A LAN protocol analysis system includes special software and sometimes special hardware (note that we use italics for the names of software-only packages). Such a system most often requires the full capabilities of a PC to run; many networks will dedicate a PC to this job alone. Hewlett-Packard packages its high-powered analyzer in a special-purpose computer equipped with a Motorola 68000 processor.

The software in a network protocol analyzer decodes the data packets that the ana-

lyzer captures as they fly across the network. All LAN protocol analyzers let you filter and sort incoming and captured data for easier processing. The top units, like Network General Corp.'s Sniffer, provide an English-language identification of the protocols in use, and evaluate any damage or irregularities in the captured data.

You can use the protocol analyzer to display packets selectively in real time or to capture activity on the network for later study. Other possibilities include setting filter criteria so that the analyzer displays only packets that are going to or from cer-

All LAN protocol
analyzers let you filter
and sort incoming and
captured data for
easier processing.

tain stations, are formatted according to specific protocols, or contain certain errors. Simultaneously setting several of these filters reduces the need for storage capacity in the analyzer. Alternatively, you can let the analyzer capture all the data it can hold—which often amounts to more than 3,000 Ethernet packets—and then use the same filters to perform a careful analysis of the captured data. Some analyzer software contains an editor so you can delete unimportant data, enter comments, print reports, and even create files in common database formats. The ease of setting filters and reviewing data is an important criterion for protocol analyzers.

NETWORK ACTIVITY FUNCTIONS

The protocol analysis capability is powerful, but most people use these systems for a much less sophisticated function. The screen they usually display is a graph of current network activity. People giving VIP tours of an organization love to bring visitors past the "network control center" so they can notice the marching bar graphs showing network (and presumably corporate) activity. These screens usually include other information such as the number of bytes or bits per second moving

across the network, the percentage of maximum network capacity being used, the number of bad packets, and some measurement of the peak load experienced since the monitor was activated.

A quick explanation of the Ethernet message demonstrates what kinds of errors a traffic monitoring system can report. A complete Ethernet message is called a *packet* or a *frame*. A legal packet has a minimum of 72 bytes and a maximum of 1,526 bytes.

The packet is divided into groups of bits called *fields*. Each field has a specific function, such as carrying the identity of the source or destination station, holding the contents of the message, or providing a statistical flag for error checking. All of the fields in a packet have a fixed length except the data field, which varies within a range from 46 to 1,500 bytes.

The *preamble field* comes at the start of each packet. It is a 64-bit pattern of alternating ones and zeros beginning with a one and ending with two consecutive zeros. This pattern allows the receiving network adapters to synchronize their bit-counting activities with the incoming message. The *cyclic redundancy check field* brings up the end of each packet. This 4-byte field contains a number used for error checking that each sending or receiving station computes statistically, based on the bits in the total packet.

From this complex pattern of bits, the typical Ethernet controller can report 17 different kinds of errors pertaining to transmission control, reception, and packet format. Some of the most common errors include *run packets*, where the data field is shorter than the standard 46 bits, and *dribble packets*, which contain leftover bits following the last complete byte.

When a transmitting station detects a collision with the packet from another station, it transmits a *jam signal* consisting of 4 to 6 bytes of arbitrary data to ensure that all stations detect the collision. Any receiving adapter reports the jam signal as a collision to any monitoring software. A *jabbering* adapter is one that doesn't wait the required 9.6 microseconds between transmitted packets.

This brief explanation serves for Ethernet systems. Token-Ring and ARCnet systems have similar error conditions.

ADDITIONAL TALENTS

Protocol analyzers offer many other functions. Most have the ability to replace arcane hexadecimal station addresses with



EDITOR'S CHOICE

- LANProbe
- Sniffer

There is no doubt that Network General Corp.'s Sniffer is the Mercedes-Benz of protocol analyzers. It is friendly, it performs excellently, and you need a large checkbook to finance the purchase. Sniffer wins Editor's Choice because its design and overall performance as a protocol analyzer are still unmatched.

For value, however, don't overlook *LANWatch* from FTP Software. This is an economy pickup truck. It isn't pretty, but for a total price of \$1,200 it fulfills all the functions required by anyone who

really needs a protocol analyzer.

If you aren't a developer of LAN application programs or communications software, perhaps you don't need a protocol analyzer. A traffic monitor is often just the right tool for network administrators and installers, and is usually lower-priced than a protocol analyzer (although it's hard to beat the price of *LANWatch*).

Hewlett-Packard's LANProbe deserves Editor's Choice in this category. This product's designers went to a lot of trouble to discover the real needs of network managers—and of many product developers. At \$12,975, the LANProbe system is expensive, but it is also pretty and functional. In fact, it's the product we

at PC LAN Labs like to use most.

If price is a limitation, then Experdata's *VigiLAN* will give you the same flexibility and a host of features for about \$5,200. This is value you shouldn't ignore.

We can't mention our favorite products without giving Brightwork Development's *Emonitor+* and its twin *ARCmonitor+* a boost. One of these two is the first and possibly the only network traffic monitoring product you need to buy if you are on Ethernet or ARCnet. For \$295 you get a lot of value. The short list of supported Ethernet adapters keeps this product from winning Editor's Choice, but it's a sure buy for anyone who uses one of those adapters. ■

meaningful names. This gives the whole process a friendlier atmosphere. Most analyzers can also use a technique called *time domain reflectometry* (TDR) to test cables for improperly terminated connections. This technique involves sending a signal out on the cable and then watching for and interpreting its echo. The systems can locate the position of open and shorted cables with varying degrees of accuracy. We tested each product that claimed TDR capabilities and found some where you might be better off witching with a bent willow twig instead.

Protocol analyzers can generate network traffic too. Some systems, like the Sniffer, contain a traffic generator that loads the network with a stream of good packets. This activity is useful for checking certain behavioral aspects of adapters and routers, but not much else.

An important troubleshooting capability contained in Novell's LANalyzer Network Analyzer lets you rebroadcast a captured data stream onto the network. Imagine, for example, that a network troubleshooter captures an exchange between a client workstation and a server that contains errant responses from the server. The troubleshooter can enter the captured data file, edit out the bad responses, and send the same requests to the server over and over again while trying to isolate the problem. This all happens without interrupting activity at the client station. A capability like this has obvious security limitations

that we'll address a little later, but it is an important troubleshooting tool.

LAN protocol analyzers aren't unique to any particular type of network operating system. You have to pick a product that works with the network adapters and cables in your system. You also should choose a product that has decoders available for the protocols your networking software uses. For example, if you have a *NetWare* server, make sure the package has IPX/SPX decoding. If you have a *LAN Manager* server, select a product that can decode NetBIOS and SMB.

BYPASSING SECURITY

As passive monitoring devices, analyzers don't log on to the server, and they aren't subject to server software security. Their ability to copy and decode packets crossing the network means that anyone with a protocol analyzer can easily find passwords used by people as they sign on to servers, and they can capture any data sent across the network. *NetWare* 386 encrypts passwords for transmission, but no operating system encrypts data files. This is typically the job of add-on encryption hardware or software. When you give someone a protocol analyzer, that person gains a wide open tap on the network.

LIGHTER ALTERNATIVES

The one thing a protocol analyzer can do for you that no other product can is to decode the contents of a packet and display

an English-language interpretation of the packet's data in addition to revealing the hexadecimal code. Users who need that function often lay out anywhere from \$10,000 to \$20,000 for the tools to do it, since that's what the top-selling products cost. Yet for \$1,200 you can buy FTP Software's *LANWatch* protocol analyzer, which in some ways is better than its higher-priced competitors.

If you don't need protocol decoding but you would like to be alerted about such matters as the volume of network activity, which stations are active, and when certain types of errant packets move across the network, there are less-costly alternative products that are easier to install and operate. We call this category *LAN traffic counters*.

LAN traffic counters are software packages that you can run on any network station. They provide excellent eye-catching displays of network activity, statistics, and even TDR functions, but they don't decode packets. Some of the traffic counters even capture packets, usually without any filtering, but they don't break down the packets or display anything beyond the hexadecimal code contained inside.

Monitrix, from Cheyenne Software, and *LANTraffic*, from LAN Tools, also provide information about traffic on the network, but in both cases the information comes from *NetWare* instead of from direct monitoring of the network environment. They also provide advanced statis-

CONNECTIVITY

LAN ANALYZERS

BRIGHTWORK DEVELOPMENT INC.

Emonitor+ ARCmonitor+

by Kimberly Maxwell

tics, such as reporting of activity over time, that clearly make them LAN management products. But since they operate at such different levels from the other packages covered here, they will be reviewed in a future issue of *PC Magazine*.

A traffic counter called *Network Inspector*, from Tiara Computer Systems, also contains special diagnostics for *NetWare*. It is included here because it monitors the network cabling directly rather than getting its management information from the network operating system. Don't assume that traffic counters will work on any network as the protocol analyzers will.

ADAPTERS AT WORK

Actually, the key element in all protocol analyzers and traffic counters is the network adapter card that links the computer into the network. The chip sets on these adapters alert the software to each passing packet, translate data formats, and move received data to RAM so the software can work on it. The chip sets also contain important elements of the TDR function.

Some programs work with many brands of adapters and others with only one. Our testing showed that the type of adapter in use significantly influenced each system's ability to report and capture data correctly under heavy loads.

PRICING AND VALUE

It's interesting to note how wildly the software products vary in price. *Emonitor+*, from Brightwork Development, lists for \$295 and is worth every penny. Anyone who cares about the operation of an Ethernet network should have this product close at hand. (If you're on an ARCnet network, the same holds true for Brightwork Development's *ARCmonitor+*.)

On the other hand, *Network Inspector*—a mere traffic counter—carries a \$1,495 price tag, which is higher than the *LANWatch* protocol analyzer from FTP Software. While *Network Inspector* has nice screens and a good data filtering and capturing capability, its overall functionality doesn't seem to justify the price.

The bottom line in this context is value. Not only should you get what you pay for, but you should use what you pay for too. LAN protocol analyzers are impressive tools. If you need one, there is no substitute. If you don't need all their power, then LAN traffic counters can give you an excellent view into the operation of your network for a lot less money.

Network managers and troubleshooters can't always be at the scene of a problem. They may even be on the other side of the continent when trouble breaks out. But they should have a way to monitor the network from a PC located outside the office so they can make sure the LAN is operating normally or help determine the cause when something goes wrong. The *Emonitor+* and *ARCmonitor+* products, \$295 each from Brightwork Development, let them do just that. Within minutes, a LAN administrator can install one of these menu-driven diagnostic tools on the network and then, with the help of a remote communications program, evaluate network activity outside the office at any time.

Which package you select depends on the topology and adapter cards you use in your network. For Ethernet networks, you would choose *Emonitor+*; for ARCnet networks, *ARCmonitor+*. Included with each monitoring software package is Tri-

ton Technologies' *ColSession*, a remote communications software package. *ColSession* allows you to dial into the network with your modem, act as a workstation, and activate the monitoring program to perform remote diagnostics. To put the bottom line near the top: these packages provide unmatched value.

RESTRICTED COMPATIBILITY

PC LAN Labs tested *Emonitor+* and found it simple to install and compatible with any network operating system that runs on an IEEE 802.3-standard adapter card. The program's major drawback is that it runs only with a few elderly Ethernet adapters: the Micom 5010 or (8-bit) 5210, Novell NE1000, 3Com 501C, or Western Digital 8003E card. If you try to run the program without a compatible card, the software will exit with an error message.

The *ARCmonitor+* also requires certain adapter cards in order to work, but the list is broader. It requires a Novell, PureData, SMC-compatible, or Thomas Conrad board in the machine acting as the monitor. Stations with other kinds of cards can still perform high-level functions like measuring network activity. The manual with the *ARCmonitor+* package gives relatively detailed information about the program, along with illustrations describing the menus you see on your screen. This is something *Emonitor+*'s manual lacks.

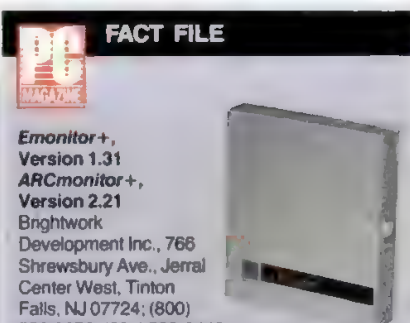
DIAGNOSING DIFFICULTIES

Once you install the *Emonitor+* or *ARCmonitor+* software, you can choose among several diagnostic tools to uncover network bottlenecks and help locate hardware failures. The programs' cable and card tests aid in pinpointing problems like faulty cards, incorrectly installed terminators, and broken cables. The *Emonitor+* program didn't attempt to give us a distance measurement for an open cable, but it clearly identified the type of problem.

The Bandwidth Usage option provides you with a marching bar chart showing what percentage of the network capacity is utilized per minute. The Network Data Capacity screen tells you the amount of data that is transmitted on the LAN. The totals are given in terms of "good" and "bad" data and packets. Good and bad aren't defined, but you do immediately know the level of data flow and whether problems exist.

In PC LAN Labs' performance tests, *Emonitor+* reported the traffic from even our esoteric short preamble test, but the

FACT FILE



Emonitor+,
Version 1.31
ARCmonitor+,
Version 2.21
Brightwork
Development Inc., 766
Shrewsbury Ave., Jerral
Center West, Tinton
Falls, NJ 07724; (800)
552-9876, (201) 530-0440.
List Price: *Emonitor+* or *ARCmonitor+*, \$295
(including *ColSession*).
Requires: 256K RAM, DOS 3.1 or later. For
Emonitor+: Micom 5010 or (8-bit) 5210, Novell
NE1000, 3Com 501C, or Western Digital 8003E
adapter. For *ARCmonitor+*: Novell RxNet
adapter; PureData PDI508, PDI508+, or
PDIUC508 adapter; Standard Microsystems
(SMC) PC 01, 100, 110, 120, 130, 200, 210, 220,
250, or 260 adapter; or Thomas Conrad ARCnet
adapter.
In Short: *Emonitor+* and *ARCmonitor+* are
Ethernet and ARCnet network diagnostic tools
that include remote communications software.
They allow a LAN administrator to monitor
network activities from a remote PC, and they
provide excellent value.

CIRCLE 613 ON READER SERVICE CARD



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—PC Magazine, May 29, 1990

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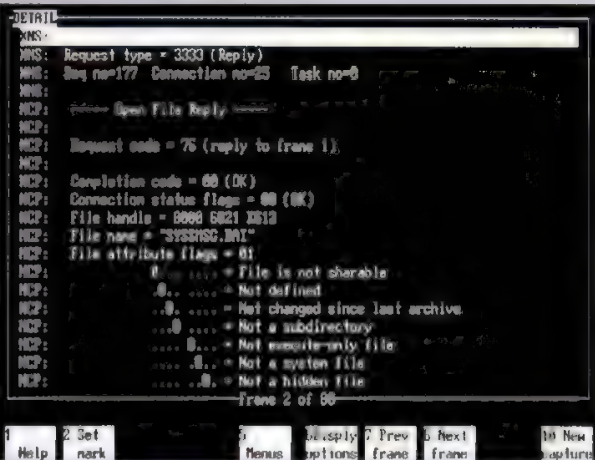
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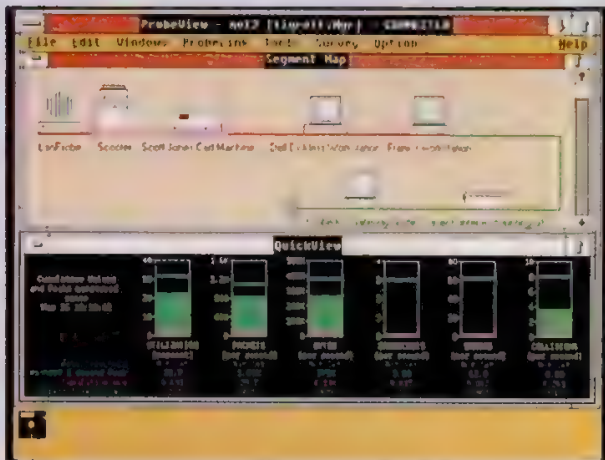
CONNECTIVITY

LAN ANALYZERS



The Editor's Choice among protocol analyzers, Network General Corp.'s Sniffer (left) provides detailed information about the function calls passed by each protocol layer in the packet. Its displays, however, are not as attractive as those of some competitors.

Editor's Choice in the traffic counter category, Hewlett-Packard's LANProbe (right) creates spectacular screens that use Microsoft Windows. This view shows two functions simultaneously: a map of the active stations and network activity charts.



counts were sometimes off by a factor of either exactly .5 or exactly 2. Obviously something happened between the adapter board and software that we don't yet understand.

The View Information Transfer screen helps you determine the source of equipment difficulties and allows you to capture data packet headers for viewing. If you have a bad physical connection between your PC and the file server, you will see messages informing you about the problem. This screen aids the repair process by accumulating and displaying packet headers so that you know which station is sending bad packets.

When you enter the View Information Packet screen, you will see the program capturing packet headers. If the monitor captures any bad packets, you can scan the memory buffer and view them in a specific column within the View Information Transfer screen. Another handy feature of *Emonitor+* is a Usermap that helps identi-

fy the user names and node ID numbers for each workstation on the LAN.

Quick installation and remote communications make Brightwork Developments' products well worth a look. Not only do you get a thorough LAN diagnostic software package for Ethernet or ARCnet, you also get a remote communications program included in the same low price. Even if you have a \$20,000 analyzer, you should have *Emonitor+* or *ARCmonitor+* on your server's hard disk simply because these programs are so useful.

VigiLAN

You don't need to be an expert to install and operate Experdata's VigiLAN, but the product is perfect for LAN administrators

and troubleshooters with far-flung responsibilities. You purchase a monitoring unit and software—for a total of \$6,500 to \$8,200 list price—which will report activity on a scheduled basis or when special events warrant a call to your PC's modem.

You use a nondedicated PC running special management software to connect to a VigiLAN monitoring unit through RS-232C cables or via modem. This connection flexibility gives you the ability to monitor one or dozens of VigiLAN devices from any distance. VigiLAN is economical for work on one local LAN, but its real value is in multiple LAN systems. It's not a true protocol analyzer, although it does a good job at capturing and displaying specific categories of packets.

The monitoring unit is enclosed in a 12-by 10-by 2-inch black box weighing 6.2 pounds. Three versions of the hardware are available at different prices. The E30-S version for a StarLAN network costs \$4,500, the E30-E for an Ethernet network is priced at \$5,200, and the E30-M for both an Ethernet and a StarLAN network lists for \$6,200. All the boxes require 100 or 200 volts of 50/60-Hz AC power and use a Motorola 68010 microprocessor, which has its own operating system.

In addition to the hardware, you need the \$2,000 *VigiLAN E30-PC* network management software that runs on the PC. The same version of the software works with all the traffic monitors. In the monitoring PC, the software requires 48K RAM. Its API (application program interface) gives programmers an avenue to create applications for communicating or working with the VigiLAN system.

UNCOMPLICATED CONFIGURATION

The software installation isn't complicated; it's just a matter of copying the program files onto the designated PC's hard disk. Installing the VigiLAN traffic monitor isn't tough either. You plug in the unit's power cord, make a network connection, and attach the box to the PC's serial port, data switch, or modem. You can order the Ethernet version of the hardware with either a thick or thin coaxial cable attachment.

After you install the VigiLAN software in the designated PC, you configure the system to work with your LAN and monitoring environment. The configuration process is simple and menu-driven. The manual and on-line help screens assist in setting up your ID numbers, the names of the networks, and whether you want to ac-

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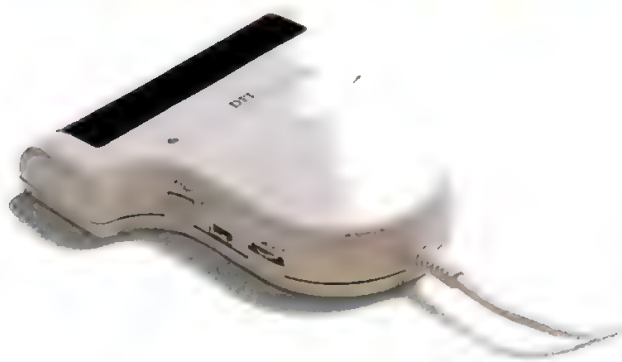
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CIRCLE 742 ON READER SERVICE CARD

CONNECTIVITY

LAN ANALYZERS

cess the VigilAN units in local or remote mode. The two access modes give enhanced flexibility to the product, particularly when you need to analyze several networks using VigilAN monitors in different locations.

You can configure the VigilAN system in the local mode by connecting the PC to the monitoring hardware through an RS-232C cable. If you have more than one VigilAN monitor on nearby networks, you can connect to them through a data switch without using modems.

Unlike most of the other products, VigilAN does not use an internal adapter for monitoring. Since the signaling speed over the 9,600-bit-per-second line is low compared with an internal video adapter, the screen display sometimes lags behind the actual activity on a heavily loaded network. We often saw a difference of several seconds between network events and an on-screen indication. This kind of delay is not significant in any testing scenarios we can imagine.

If you want to connect to a VigilAN monitoring unit over telephone lines, you set up the software in the remote mode and attach a modem set for auto-answer to the VigilAN unit at that site. Then, at your site, install the system management software on a PC that is connected to another modem.

Typically, the PC polls the VigilAN monitors at regular intervals to pick up reports of specific types of traffic that you have designated through the system menu. Alternatively, you can program the VigilAN monitor to call the PC through the

modem under certain conditions, such as an excessive number of bad packets or the presence of certain types of traffic.

FULL FUNCTIONALITY

When you select the Real-Time option in the main system menu, you will see a list of options that include nine different VigilAN performance analysis and diagnostic functions. The first function, LAN monitoring, provides you with the general operating-system characteristics of the network. It also gives the percentage of the network bandwidth used and information about bad packets and collisions.

Through the LAN Monitoring menu, you can view the type of traffic on the network and set performance thresholds that trigger an alarm message when they are exceeded. If, when you are working in real time, you are interested in seeing a list of stations with error frames indicating the type and the time of each error, LAN Monitoring is also the function to use. It not only helps when you need a quick identification of a potential problem, it offers information that helps resolve it.

Another function, LAN Address Learning, lets you automatically acquire and store the physical station addresses that are active on the network. With this information in hand, you can assign logical names to the separate stations.

The Specific Station function measures the amount of traffic transmitted and received on up to 16 stations simultaneously. You can see a percentage of network utilization over a defined period and a percentage of the peak network utilization value since you began using the function. You can also spot the number of frames of different types transmitted and received by the station.

The Automatic Station function is somewhat different from the Specific Station. This function measures the amount of traffic transmitted across the network from up to 256 stations, and it ranks the stations from busiest to least active. You can use this function to identify a station that doesn't receive any traffic.

The Node Connection function monitors the amount of traffic sent from one node to another. It's useful if you need to place a bridge or router on your network; it also identifies the people using a particular server. One option helps find stations that receive packets but don't seem to reply in an orderly manner, which may point to a

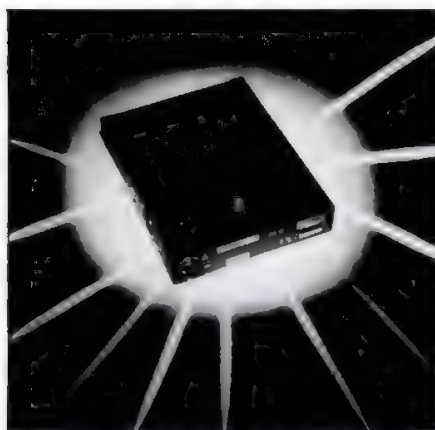
bad transceiver, a corrupt transceiver cable, or a configuration error in a node.

The Trends option on the main menu lets you take a quick glance at the efficiency of your network. You can view calculations as well as a skyline bar graph of how well your network is functioning and how its resources are being utilized. The Trend mode provides the load factor and the number of errors for each of the monitored networks. Within it, you can choose alarm and error messages that VigilAN stores on your computer's hard disk.

Also in the Trend mode, you can select between current load and error values for several networks at the same time, or the network load trend for one network with one VigilAN unit connected. You also can choose parameters that show the error counts on your own network, including percentages for the load and collisions, or number values indicating the alignment, preambles, jabbers, runts, and CRC errors. You can ask to see statistics like the preamble threshold in bits per second or jabber thresholds in milliseconds.

If you compare the VigilAN product with others, you will find it's a leader in providing thorough statistical information. One of VigilAN's few drawbacks is that it does not include a cable test to check whether cables used on the network are open or shorted.

Experdata's VigilAN is a top-notch network management system. Like Hewlett-Packard's LANProbe, it provides a powerful and flexible management system



Experdata's VigilAN hardware contains a Motorola microprocessor that collects network statistics. Meanwhile, an application running in a networked PC takes the data and displays it graphically. VigilAN's monitor can connect to the network at any point.



FACT FILE

VigilAN
 Experdata Inc., 10301 Toledo Ave. South,
 Bloomington, MN, 55437; (612) 831-2122.
List Price: E30-S (for an StarLAN network)
 \$4,500, E30-E (for an Ethernet network), \$5,200;
 E30-M (for both networks), \$6,200. *VigilAN E30-PC*
 network management software, \$2,000.
Requires: IBM PC AT or PS/2 or compatible with
 48K RAM, serial port, VGA or EGA, DOS 3.1 or
 later or OS/2.
In Short: VigilAN is a standalone network
 management system that gathers network
 diagnostic data and lets you use a PC remotely or
 locally to view network statistics. Inexpensive in
 comparison to competing systems like Hewlett-
 Packard's LANProbe, this small black box is a
 convenient way to diagnose network problems
 and monitor activity on single or multiple LANs

CIRCLE 614 ON READER SERVICE CARD

CONNECTIVITY

LAN ANALYZERS

that will satisfy sophisticated LAN administrators and product developers alike. Its design features are impressive, and its price is about half that of the competing HP system.

FTP SOFTWARE

LANWatch

by M. Keith Thompson

Some protocol analyzers are like jewelers' tools—beautiful and precise devices. *LANWatch*, a \$1,200 package from FTP Software, is more like the famous Swiss Army knife. It's not pretty, but you can do nearly anything with it, and the price is very reasonable.

FTP specializes in networking software, with extensive experience in the TCP/IP arena. *LANWatch* derives from the *Netwatch* program originally designed and developed by MIT. FTP developed other parts of the program for NASA and made many other enhancements for commercial distribution. The software now contains a huge (over-140-entry) database of protocols that it can identify and symbolically decode.

Installing the software is as simple as copying it to a subdirectory. The program doesn't modify the CONFIG.SYS file, so you will have to use a text editor to install the proper driver for the network adapter board you use. *LANWatch* works with a wide variety of Ethernet adapters and with Token-Ring adapters from IBM and Proton. After installing the files, you reboot to load the driver, type LW to start the program, hit the "?" key to bring up the menu, and pick the course of action you want to follow.

The *LANWatch* package also includes annotated source code and examples of both parsing and packet-decoding software so that people developing communications products can write their own parsing software. Because FTP Software specializes in TCP/IP products for PCs, the company provides programs able to analyze TCP/IP packets in depth.

PRACTICALITY FIRST

The screens presented by *LANWatch* are practical rather than pretty. This program won't make the network analysis desk a place where every VIP on a facility tour will stop to admire the great graphics. Bar graphs, for example, consist of asterisks

running across the screen. The package does turn out good information, however, reporting short, long, dribble, and bad CRC packets. Ethernet collisions show up as short or dribble packets.

LANWatch's biggest strength is its ability to record events on the network and let you review the captured data. The program defaults to a 3,000-packet ring buffer, but you can let it dynamically allocate RAM until it fills up system memory with everything it can hold. Then you can search forward or backward in the buffer looking for certain types of messages, stations IDs, or protocols. The tools in the *LANWatch* package make it easy to trace interchanges, actions, and events.

In its default mode, *LANWatch* records only the first 300 bytes of each packet. This gets the message headers and important parts of the packets while saving space. If you want more information, you can instruct the program to record more of the packet. Later you can edit the captured data, enter comments into the file, print out sections of the material, or save everything to disk.

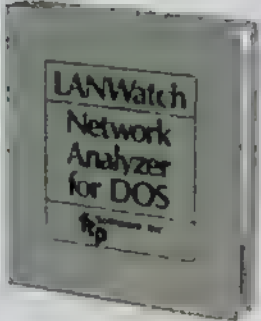
MISSING ATTRIBUTES

LANWatch lacks four attributes shared by some of the other protocol analyzers: a



FACT FILE

LANWatch
FTP Software, 26
Princess St., Wakefield,
MA 01880-3004; (617)
246-0900.
List Price: \$1,200
Requires: 384K RAM,
network adapter, DOS
2.0 or later.
In Short: *LANWatch* is an inexpensive, powerful,
and flexible network analyzer. It offers 80 percent
of the features of the more expensive units at 10
percent of the price.



CIRCLE 615 ON READER SERVICE CARD

traffic generator, an ability to replay captured packets, a measure of the percentage of network load, and a stiff price tag. We haven't yet figured out much use for a traffic generator, so that deficiency doesn't make much difference. We do wish the product could replay the data it captures, especially since you can edit the file so nicely. As for the percentage of network load, you can do the math in your head if you know that an Ethernet network can

theoretically handle 10 megabits per second. And as for the low price, we don't mind that at all.

LANWatch's performance is directly related to the network adapter board you provide. We had problems with inaccurate reports of short packets when we used a Western Digital WD8003 Ethernet adapter in a heavily loaded network. The problem went away when we switched to a new WD8013-EBT 16-bit adapter. *LANWatch* was doing its job, but the adapter wasn't. Boards that slowly move data to the computer's bus cause *LANWatch* to lose packets in a heavy-data environment, but *LANWatch* does attempt to tell you when it's not able to capture packets because of high throughput on the wire.

LANWatch is certainly the most practical protocol analyzer we've reviewed. It isn't pretty or fancy, but it quickly can become a favorite of anyone who appreciates useful tools.

HEWLETT-PACKARD CO.

HP 4972A

by M. Keith Thompson

The Hewlett-Packard 4972A is built by engineers for engineers. It works only on Ethernet 802.3 networks, but it decodes many protocols over the same wire. The 4972A is one of a family of protocol analyzers from HP. The base system, priced at \$18,350, analyzes Ethernet statistics. Optional protocol decoders include DECnet, ISO, TCP/IP, and XNS for \$950 each.

HP houses the custom Motorola 68000-based computer in a large, heavy-duty case. As you would expect from HP, the 4972A is a rugged, well-built analyzer. Although it is nominally portable, you certainly will not confuse it with a Toshiba T1000. The 4972A weighs 49 pounds and is larger than the original Compaq portable. The standard unit comes with a 20MB hard disk, 3.5-inch floppy disk drive, and 1MB of RAM. All it does is act as a protocol analyzer. A high-resolution RGB video adapter board displays the statistics on an optional external color monitor, the HP 35741B (\$1,195).

START WITH THE TUTORIAL

Since the 4972A comes preconfigured, installation is as easy as plugging in the power cord. A tutorial program helps you learn the full power of the 4972A easily and at

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V.32

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c/o Fifth Generation Systems, Inc.

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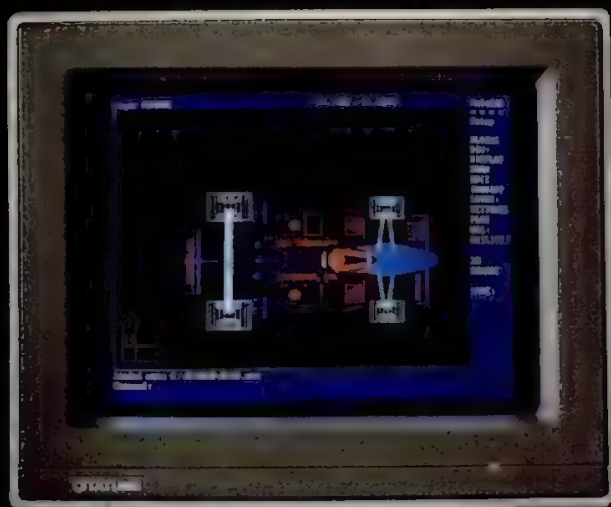


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In a recent comparison of 26 monitors from twenty manufacturers, *Byte Magazine* ranked another Tatung monitor first in performance.

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	NEC Multisync 2A	NEC Multisync 3D	Tatung Omniscan CM-1496X	Tatung Omniscan CM-1498X
1024x768 Max Resolution 8514/A Compatible	No	Yes	Yes	Yes
Super VGA (800x600)	Yes	Yes	Yes	Yes
Dot Pitch	0.31mm	0.28mm	0.31mm	0.28mm
Price †	\$799	\$1,049	\$749	\$799

* Interlaced resolution available with the ATI VGA Wonder™, Genoa Super VGA 6400™, Paradise VGA 1024™ and other leading IBM 8514/A™—standard graphics adapters. † Suggested retail price and features February 1, 1990. All trademarks are the property of their respective owners.

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CONNECTIVITY

LAN ANALYZERS



The HP 4972A, from Hewlett-Packard, is a luggable computer dedicated to its role as a protocol analyzer; it cannot function as a PC. It uses a Motorola processor and a unique operating system.

your own pace. The tutorial simulates the real-world use of the machine to solve a problem, guiding you through each step of the analyzer's operation.

HP also includes a utility package, which consists of a LAN test library, a cable test application, and remote-control PC software. The LAN test library helps you solve common networking problems by providing examples and starting points. The 4972A's cable test feature works as well as it did with the other products we tested, but HP believes that if you really want to know where your cable problem is you should buy one of its precision cable-fault-locating instruments.

The 4972A is primarily function-key-driven. Function-key labels at the bottom of the screen correspond to the majority of commands. This allows one-button access to most operations. Other menu items require normal keyboard input.

The 4972A collects data on your network and presents it to you either on its network summary screen or as a graph. The network summary screen provides you with information on three important aspects of network operations. In the Utilization and Throughput section, the software represents network utilization as a percentage of the bandwidth being used on the LAN. It also measures the number of frames or bits that have passed through the network and arrives at a throughput figure. The Frame Parameters part includes frame size measurements as well as a total frame count and a byte count. When the frames are faulty, the Errors and Collisions portion categorizes them as misaligned frames, runts, and jabbers or as having bad Frame Check Sequences.

FILTERS TO FIND WHAT YOU NEED

The HP 4972A lets you do some categorizing of your own. The system contains some of the most sophisticated and complicated capturing and triggering filters around. HP accomplishes this with a programming language that is designed to be extremely selective. If-then and GOTO logic allows you to look at information of interest instead of mass amounts of network traffic data. HP also offers the Protocol Interpreter Development Environment, which gives programmers a way they can write routines to decode their own protocols.

Similarly, you can configure the 4972A to collect performance information automatically. A setup screen allows you to de-



FACT FILE

HP 4972A

Hewlett-Packard Co., P.O. Box 7050, Colorado Springs, CO 80933-7050; (719) 531-4420.

List Price: \$18,350.

Requires: An Ethernet 802.3 network.

In Short: The HP 4972A is built by engineers for engineers. Even though it is not the easiest to use, the HP 4972A will not let you down.

Sophisticated hardware design and excellent customer service and support make it a good choice for serious protocol analysis work.

CIRCLE 616 ON READER SERVICE CARD

fine a sequence of tests for the analyzer to perform. Once preset thresholds are met, the sequence proceeds according to the results of the tests. This becomes an invaluable tool for finding sporadic network errors. Like most of the other products tested, the 4972A contains a name table associated with each 12-hex-digit Ethernet address, which makes it easier to find not only the errors in the packets but their origins as well.

Hewlett-Packard, always known for quality and completeness, keeps to that tradition with the 4972A. The system doesn't decode all protocols as well as the Sniffer, but it's much more capable at the hardware level because its Ethernet adapter is better at accessing information from the wire. All the underlying information is available to the system; we only wish the HP software would display it in a more understandable form—similar to the Sniffer's English-like interpretation.

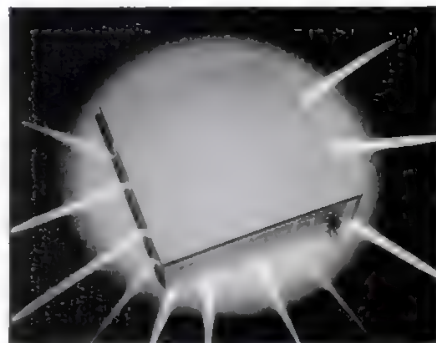
HEWLETT-PACKARD CO.

LANProbe

by M. Keith Thompson

The \$14,000 LANProbe is very different from the HP 4972A reviewed above. An engineer can program the 4972A to do practically anything on a network. The LANProbe already knows how to do everything a sophisticated network manager or developer would want. Although HP does not market the LANProbe as a packet analyzer, it has some capabilities in that area. The stunning screens the LANProbe creates through *Microsoft Windows* make the system a joy to use and guarantee that people will stop by the network administrator's desk just "to see how the network is doing."

The LANProbe package monitors, tests, and diagnoses activity on virtually every aspect of a network. It displays LAN problems in terms of cabling, communications software, traffic loads, equipment malfunctions, and even user errors. The system is designed for remote access, so troubleshooters can view LAN activity from across the country as easily as they can see what happens on their own desktops. Considering its power, the price of the LANProbe seems reasonable, but the total system cost depends in part on how much you spend on the extra PC that's required to run *Microsoft Windows* 286.



Hewlett-Packard's LANProbe includes two unique pieces of hardware and a *Microsoft Windows* application that runs on one of the networked PCs. One piece of equipment is placed at each end of a network using Ethernet cable; this gives the LANProbe system an end-to-end view of the LAN, allowing it to produce a map that shows the exact location of each node. At the same time, it collects data, which can be viewed in a variety of interesting displays.

SIMPLIFIED PENCIL SHARPENER

by RUSS SOLOSER

PROFESSOR BUTTS GETS HIS THINK-TANK WORKING AND EVOLVES THE SIMPLIFIED PENCIL SHARPENER.

OPEN WINDOW (A) AND FLY KITE (B). STRING (C) LIFTS SMALL DOOR (D), ALLOWING MOTHS (E) TO ESCAPE AND EAT RED FLANNEL SHIRT (F). AS WEIGHT OF SHIRT BECOMES LESS, SHOE (G) STEPS ON SWITCH (H) WHICH HEATS ELECTRIC IRON (I) AND BURNS HOLE IN PANTS (J).

SMOKE (K) ENTERS HOLE IN TREE (L), SMOKING OUT OPOSSUM (M) WHICH JUMPS INTO BASKET (N), PULLING ROPE (O) AND LIFTING CAGE (P), ALLOWING WOODPECKER (Q) TO CHEW WOOD FROM PENCIL (R), EXPOSING LEAD. EMERGENCY KNIFE (S) IS ALWAYS HANDY IN CASE OPOSSUM OR THE WOODPECKER GETS SICK AND CAN'T WORK.



Considering the way most utilities function, you have to wonder where the designers got their inspiration.

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For example, to call up a file when you can't remember the name,

Magellan's viewing screen says a lot about Magellan: simple, uncluttered and easy to understand.

just type in the word, phrase or concept you need to find. Magellan will come back with a list of relevant files in seconds, arranged according to how well they match the search criteria.

View each one as it actually appears in its application, even if it's a graphics file. Find the right file and launch the application with a single keystroke.

Magellan is the only utility that lets you view deleted files. To UnDelete, all you have

to do is just type in the file name.

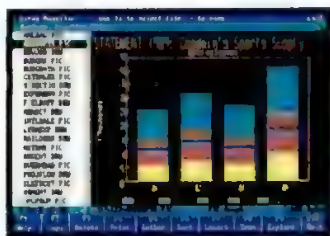
Magellan also has PKzip®, the file compressor that can condense data files by up to 50%. You can even view compressed files without expanding them. And when you do need to expand one, a single keystroke will do it.

We've reduced a number of other commands down to a single stroke, as well. So you can quickly Copy, Delete, Move, Sort or Rename files, groups of files, or even entire directory branches in the Tree mode. And Verify files for any changes due to corruption or contamination, just as easily.

All of which is why *PC Magazine* said, "Magellan could well be the finest utility ever written for the PC." And why every major computing magazine has given it practically every award they have.

If you own the original Magellan, you can upgrade to new Magellan 2.0 for only \$39. Or upgrade from a competitive utility* for a bit more. Call **1-800-TRADEUP, ext. 569**. To get a better idea of how Magellan works, just call the same number and ask for a free auto demo disk.

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Introducing Lotus Magellan 2.0

*Competitive utilities eligible for upgrades are Norton Commander®, Norton Utilities®, PC Tools®, Fastback®, XTree®, XTreePro™ and Mace Utilities®. © 1990 Lotus Development Corporation. All rights reserved. Lotus and Magellan are registered trademarks of Lotus Development Corporation. PKzip is a registered trademark of PKWARE, Inc. Norton Commander and Norton Utilities are registered trademarks of Peter Norton Computing, Inc. PC Tools is a trademark of Central Point Software, Inc. Fastback is a registered trademark of Fifth Generation Systems. XTree is a registered trademark and XTree-Pro is a trademark of Executive Systems, Inc. Mace Utilities is a registered trademark of Paul Mace Software, Inc.

CONNECTIVITY

LAN ANALYZERS

FACT FILE

EDITOR'S CHOICE

LANProbe

Hewlett-Packard Co., 19310 Pruneridge Ave.,
Cupertino, CA 94304; (800) 752-0900 ext. 1217.
List Price: \$12,975.

Requires: Ethernet network card or one serial port, IBM PC AT or compatible with 2MB RAM, 40MB hard disk, EGA or better card and monitor, Microsoft Windows, DOS 3.1 or later. Mouse recommended.

In Short: An excellent network monitor and good protocol analyzer designed for sophisticated LAN administrators. LANProbe displays the network traffic in multiple graphic windows, permitting instant interpretation of information. The unique mapping feature is a useful extra touch.

CIRCLE #17 ON READER SERVICE CARD

POSITIONING AND MAPPING

Installing the LANProbe requires a bit of planning. The system consists of three parts: the LANProbe Segment Monitor, the NodeLocator, and the *ProbeView Manager* software, which runs on the network administrator's PC along with *Windows 286*. When you set up the system, you have to install the LANProbe Segment Monitor on one end of an Ethernet cable and the NodeLocator on the other. If you think you'll ever extend the network cable, you must be prepared to move the hardware monitoring elements.

The size of the units shouldn't present too much of a problem if you need to move them. The Segment Monitor is about the size of a half-height IBM PC AT case. Its front panel displays limited information about the network load and cable status. This is designed to help someone working in the wiring closet who's away from the controlling PC. A graduated LED display shows the percentage of network load; it pulsates back and forth like the level indicator on a stereo cassette machine. Pushing a simple front-panel button forces a cable test, and the results are indicated by a pass/fail light. In operation, the *ProbeView Manager* software can run on any networked PC and still gather statistical data from the Segment Monitor.

One unique feature of the LANProbe system is the LAN Map it creates. The system automatically identifies all the active nodes and creates a map showing them in sequence on the cable. The software gives you tools to name nodes and supplies appropriate icons for servers and workstations. Each station icon includes informa-

tion about the type of adapter installed and the node's location along the cable.

This LAN Map facility can save network managers many hours of work. By automatically rearranging the network map when devices change locations, managers can avoid spending time manually revising charts and maps. Then when problems arise, they can quickly locate the glitches using the visual map.

The NodeLocator resembles a small external modem and is the brains behind *ProbeView Manager's* LAN mapping feature. It automatically documents the physical location of nodes on the LAN.

ProbeView Manager communicates with the LANProbe over one of three interfaces. An RS-232 interface creates a direct connection, although it requires extra cabling. A modem comes with the package for dial-up operation. 3Com 501C or HP 27210B Ethernet cards are the most common way to access the LANProbe.

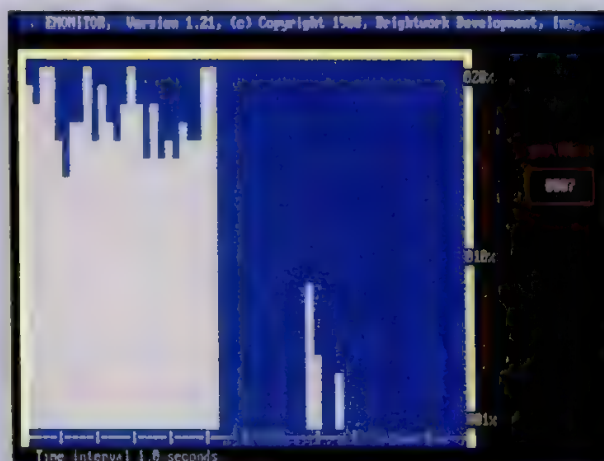
KNOWING WHAT COUNTS

The key to managing information is distinguishing the important from the trivial. This is where the *ProbeView Manager's* triggering and filtering options shine. The network manager simply chooses the important protocol and station combinations and captures only the relevant packets.

The software shows network performance using vertical bar charts that depict packets per second, bytes per second, errors, collisions, and other significant information. The display is impressive.

The LANProbe also does an adequate job of decoding the contents of various types of packets, but it doesn't match the clear explanations provided by the Sniffer or SpiderAnalyzer systems. The product design tilts more toward serving LAN administrators rather than application developers. The files that the decoding software creates are easy to read, however, and it's no problem to import them into a database for further analysis.

Running a system under *Microsoft*



Emonitor+, from Brightwork Development, gives a good picture of LAN traffic over a period of time (left). In this screen, network utilization peaked at 20 percent of the Ethernet bandwidth. The graph scales for different utilization levels.

Protocol analyzers go further than traffic monitors and decode network activity data at the packet level. The LANalyzer Network Analyzer, from Novell, (right); displays a numeric function code describing the actions of various messages in the packet.



NetWare 386 sets new standards for performance, architecture, sheer power, and flexibility. NetWare 386 is even 486-aware, the first commercial program to be so. It opens up

PC MAGAZINE, Jan. 16, 1990

Although such capacity in a PC LAN is breathtaking, it isn't NetWare 386's only boon. Management woes have been greatly reduced. With dynamic resource configuration, a network manager can allocate RAM in real time.

LAN Magazine, Feb. 1990

Novell NetWare 386

Novell upped the network ante in 1989 with a true 32-bit server operating system, NetWare 386. This version features support for up to 250 users, easier installation and setup, an innovative and more reliable method of data protection.

InfoWorld, March 5, 1990

Novell NetWare 386 (version 3.0) permits vastly greater numbers of users on a server, improves performance and security, and is significantly easier to install.

BYTE, January 1990

After everything that's been said about NetWare® 386,



*InfoWorld
1989 Product of the Year*



*LAN Magazine
1989 Product of the Year*



*BYTE
1989 Annual Product Award*



*PC MAGAZINE
1989 Technical Excellence Award*

we're honored.



For network solutions,
you should be seeing red.

CIRCLE 322 ON READER SERVICE CARD

CONNECTIVITY

LAN ANALYZERS

SUMMARY OF FEATURES: LAN PROTOCOL ANALYZERS AND TRAFFIC COUNTERS

Products listed in alphabetical order by category

	HP 4972A Hewlett-Packard Co. \$18,350	The LANalyzer Network Analyzer Novell Inc. \$9,980	LANProbe Hewlett-Packard Co. \$12,975	LANWatch FTP Software \$1,200	NetProbe 3Com Corp. \$995	Sniffer Network General Corp. \$12,500 (kit)	SpiderAnalyzer 320 Spider Systems \$10,500 (kit)
GENERAL FEATURES							
Product type	Protocol analyzer	Protocol analyzer	Protocol analyzer	Protocol analyzer	Protocol analyzer	Protocol analyzer	Protocol analyzer
ARCnet monitoring	☐	☐	☐	☐	☐	☒	☐
Ethernet monitoring	☒	☒	☒	☒	☒	☒	☒
Token-Ring monitoring	☐	☒	☐	☒	☒	☒	☒
Works with multiple brands of adapters	☒	☐	N/A	☒	☐	☐	☐
PROTOCOL DECODERS							
AppleTalk	☐	☒	☐	☒	☒	Optional (\$995)	Optional (\$750)
DECnet	Optional (\$950)	☒	☒	☒	☐	Optional (\$1,995)	Optional (\$750)
NCP (NetWare)	☐	☒	☐	☒	☐	Optional (\$995)	Optional (\$750)
NFS	Optional (\$950)	☒	☐	☒	☐	Optional (\$995)	Optional (\$750)
SMB	☐	☒	☒	☒	☒	Optional (\$995)	Optional (\$750)
TCP/IP	Optional (\$950)	☒	☒	☒	☒	Optional (\$995)	Optional (\$750)
XNS	Optional (\$950)	☒	☒	☒	☒	Optional (\$995)	☒
NETWORK MONITORING							
Recognizes nonstandard packets	☒	☒	☒	☒	☐	☒	☒
Displays data in multiple windows	☐	☒	☒	☐	☐	☒	☒
Shows throughput in graphics format	☒	☒	☒	☒	☐	☒	☒
Shows throughput in numeric format	☒	☒	☒	☒	☐	☒	☒
Creates a map of LAN stations	☐	☒ (Token-Ring networks only)	☒	☐	☐	☐	☐
Shows distance to short or open cable	☒	☐	☒	☒	☐	☒	☒
Lets you examine captured packets in a file	☒	☐	☒	☒	☒	☒	☒
Lets you edit the captured packets	☒	☒	☒	☒	☒	☒	☒
NETWORK SIMULATION							
Contains an internal packet generator	☒	☒	☐	☐	☐	☒	☒
Replays packets over the network	☒	☒	☐	☐	☐	☐	☒
Lets you create an intentional jam	☐	☒	☐	☐	☐	☒	☐

Editor's Choice ☒—Yes ☐—No

N/A—Not applicable: the product does not have this feature.

Windows has some inherent advantages and disadvantages. On the plus side, *Windows* provides a good environment for displaying graphics information. Users can create different views of the pertinent data with multiple types of graphs, while *Windows* sizes and positions the graphs on-screen for maximum clarity. The LANProbe's multiple-window support outdoes the competition, allowing you to see all types of information at once. The major disadvantage is *Windows*' slow response time and its appetite for large amounts of memory and high-resolution graphics.

Nevertheless, the LANProbe was one of the best units we tested. We liked the features, and the *Windows* user interface is becoming more popular every day. The system breezed through tests with ease and provided excellent network monitoring.

Sniffer

by M. Keith Thompson

Sniffer, the name of a product line from Network General Corp., has practically become the generic term for network protocol analyzers within the past few years. This is partly due to a healthy promotional budget, and partly to the crusading efforts of Network General's chief executive officer, Dr. Harry Saal. Network General now offers two types of products: portable 386-based computers that come configured with hardware and software, and kits (for Compaq Portable 386s) consisting of a network card and analysis software. These

products support the largest range of protocols currently available in the network analyzer market.

Network General offers configurations for many types of LANs. The \$24,000 6MB Compaq Portable III system comes with one network adapter. If you want it to analyze a second network with a different topology, you can buy an add-on package containing a card and software for an additional \$5,000. For a strictly one-network topology, Network General markets a 5.6MB Toshiba 3200SX for \$16,750. And if your organization already has a Compaq Portable III, you can select Network General's \$12,500 add-on kit that includes a network interface card, an expansion unit that you attach to the back of the Compaq, and analysis software.

These products provide everything you

CONNECTIVITY

LAN ANALYZERS

Emonitor+ or ARCmonitor+ Brightwork Development Inc. \$295			Network Inspector Tiara Computer Systems Inc. \$1,994 (with Ethernet card)			VigilAN Experdata Inc. \$6,500-\$8,200		
Traffic counter			Traffic counter			Traffic counter		
■ (ARCmonitor+)			□			□		
■ (Emonitor+)			■			■		
□			□			□		
■			□			■		
N/A			N/A			N/A		
N/A			N/A			N/A		
N/A			N/A			N/A		
N/A			N/A			N/A		
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■			□			□		
□			■			□		
■			■			□		
□			□			□		
N/A			N/A			N/A		
N/A			N/A			N/A		
N/A			N/A			N/A		

need to get the Sniffer up and running as a packet counter. But if you want to use it as a protocol decoder, you still need some extra software. For prices ranging from \$995 to \$1,995, Network General provides just under a dozen different protocol interpreters, including AppleTalk, DECnet, ISO, NCP, NetBIOS, SMB, SNA, SUN, TCP/IP, and XNS. You can run them over ARCnet, Ethernet, StarLAN, and Token-Ring topologies. In case you are using one of the few protocols not supported, the Sniffer has a C programming interface that allows you to write your own protocol interpreter. The protocol decoders translate all of the binary data in a packet into English words. Actually, decoding the seven layers of communications protocols is the Sniffer's main focus.

Unlike its competitors, Network Gen-

eral supports only the Compaq Portable III and Toshiba 3200SX; you cannot put its kits in any other computers. The Sniffer does not really justify this inflexibility with any advantages over competing products from FTP Software, Novell, and Spider Systems, which let you pick your own PC.

The Sniffer is undoubtedly the best protocol analyzer around, but that does not necessarily make it the best network analyzer for you. Decoding protocols is only a small portion of the network analyzing process. Most network managers today don't need an in-depth view of the underlying protocol actions. People who write network application software do. For them, the Sniffer is an invaluable tool that can often save days of debugging time. But network managers in typical business settings get enough information from lower-priced products that solve most of their network problems.

Because we tested the complete Compaq portable unit, we did not go through the process of installing the kit; the unit arrived fully configured and ready to plug in. We understand, however, that installation is a trivial process, and we can vouch for the well-written, well-illustrated documentation that Network General includes with its packages.

A WHIFF OF SNIFFER FEATURES

The Sniffer captures and displays data based on criteria you select when you set your options. To avoid missing any packets, the software offers two capture modes. The standard capture mode analyzes the data as it arrives on a first-come first-served basis. For heavy network traffic, the high-speed mode captures all the incoming data and then parses it.

Equipped with complex capture, filter, and triggering options, the Sniffer only displays what you want to see when you want to see it. If the data is too much for you to comprehend on the screen, the Sniffer saves the data to a disk file for later evaluation. But while the Sniffer allows you to examine saved packets, you do not have the ability to retransmit the captured packets. The traffic generation portion of the Sniffer simulates network traffic by sending a steady stream of good packets, and those are the only ones that can be sent over the network.

Having focused so much on the protocol part of the network, Network General omitted some essential network monitor-



FACT FILE

EDITOR'S CHOICE

Sniffer

Network General Corp., 4200 Bohannon Dr., Menlo Park, CA 94025; (415) 688-2700.

List Price: Add-in kit (includes card, expansion unit, and software), \$12,500; with Compaq Portable III with 6MB RAM, \$24,000; with Toshiba 3200SX with 5MB RAM, \$16,750; protocol interpreters, \$995 to \$1,995 each.

Requires: For add-in kit: Compaq Portable 386 with 6MB RAM and hard disk with 40MB free.

In Short: A pricey but excellent protocol analyzer with above-average network management features. Network General offers a wide variety of protocol interpreters and prepackaged portables. The product is primarily designed for people requiring detailed information about the contents of packets.

CIRCLE 618 ON READER SERVICE CARD

ing features. The Sniffer's inability to see damaged network traffic, in fact, makes it completely useless in some cases. For example, if a component of the network damages the preamble of any of the packets and causes serious software problems, the Sniffer can not see these packets. Also, the way the Sniffer reports and displays data on-screen is relatively hard to understand.

Another oddity of the Sniffer is the clicking you hear from its speaker—an informal way of representing the amount of traffic on the network. It sounds somewhat like a Geiger counter. The Sniffer allows you to disable this feature, which is fortunate (especially if you are a nuclear physicist).

Particularly welcome is the Sniffer's ability to store a name corresponding to an Ethernet address in its name tables. This allows you to see the computer name within the data packets instead of an obscure hexadecimal address. The Sniffer configured for Ethernet also has a built-in cable testing function that uses time domain reflectometry (TDR). This feature sends out a signal and, based on the response time, determines whether there is a cable problem and where.

Because it is the most expensive product we tested and it lacks some of the reporting features found in the other products, we don't recommend the Sniffer for the everyday network manager. The Sniffer is best suited for applications developers and hardware designers, who will be able to make the best use of its heavy-duty protocol analysis abilities.



PERFORMANCE TESTS: LAN PROTOCOL ANALYZERS AND TRAFFIC COUNTERS

All the products we tested, protocol analyzers and traffic counters alike, count standard Ethernet packets the same way. Only LANProbe and The LANalyzer Network Analyzer report everything they see, including nonstandard packets.

Our tests of protocol decoding involve sending prerecorded streams of data across the network and capturing them on each protocol analyzer. We use three different recordings containing legal packets with several types of protocols. The chart shows the protocol levels clearly interpreted by each device. (Note that many protocols have subsets, and some analyzers label various protocol levels with different but synonymous names.)

The **Unix Protocols** test sends a data stream generated by several PCs and a Sun computer running Unix. One PC requests a file from the Sun using the NFS file system. The Sun computer replies, and the performance test chart lists the protocols the analyzer has detected during the exchange.

The **LAN Manager Protocols** test sends a data stream generated by several PCs and a file server running the *3+Open LAN Manager* operating system. A workstation opens a file and attempts to lock data in the file. The test chart lists the protocols the analyzer has detected during the exchange.

The **NetWare Protocols** test sends a data stream generated by several PCs on a network with a file server running *Advanced NetWare 286*, Version 2.15. A workstation attempts to open and read a menu file on a Novell file server. The test chart lists the protocols the analyzer has detected during the exchange.

For the **Cable Open** test, we present each device with an unterminated thin Ethernet cable 22 feet in length. We list the results reported by each product that is able to analyze the status of the cable.

In the **Bad Packets** test, we generate packets with an abnormal preamble of 16 bits instead of the usual 62. The other packet fields are normal. A yes answer in the chart indicates that the product is able to detect these abnormal packets.

For the **Forced Collisions** test, we generate traffic from two PCs but program one machine to jam the packets of the other with its own transmissions. The "bad" machine causes short and jam pattern packets. A yes answer in the chart indicates that the product is able to detect these abnormal packets.

Our protocol tests show the levels that each product was able to interpret. The glossary on the facing page offers a simplified explanation of the terms the protocol analyzers use to describe these levels. Since some of the protocols were developed by specific companies, the results of these tests can help you make sure that the analyzer you choose will interpret traffic for the type of network you have.

What doesn't come across fully from the charts is the clarity of protocol interpretation. The SpiderAnalyzer 320 and especially the Sniffer provide uncommonly descriptive explanations, covering each packet's function in plain English. The LANalyzer Network Analyzer and LANWatch are long on details but not as chatty; they give descriptions of the protocols used but do not indicate whether those protocols are in good or bad condition. NetProbe works beautifully for 3Com's own networks, but it isn't designed as an all-purpose tool.

We also made an attempt to test the ability to check for improperly terminated cable connections, but we found that not every product can do it at all. After seeing the test results of those products that did and how far off the mark they

were, we understand why.

As Harry Saal of Network General told us, "There is no standard way to handle illegal Ethernet packets!" By "illegal," he meant those that do not conform to the IEEE 802.3 standard. But nonstandard packets can appear on any network, and sometimes they create havoc. Bad adapters, noisy cables, and malfunctioning bridges are all possible sources of incomplete packets.

The Bad Packets test sent nonstandard packets with a short preamble across the network. Of course, these packet types do not represent every way that faulty equipment can mangle a packet. Some analyzers will recognize packets with faults in certain sections but not in others.

The Forced Collisions test simulates what can happen when an adapter becomes deaf to transmissions on the cable, when a network router or bridge fails, or when the network cabling is poorly designed. Repeated collisions test the traffic counter's ability to report these errors.

The software and adapter boards these products use both play an important role in determining what packets they see and report. Devices like The LANalyzer don't miss a packet, but then neither does the inexpensive *Emonitor+* program if you give it a good adapter to read. The Sniffer and SpiderAnalyzer are pickier. Their software ignores some packets with errors in the opening sections. NetProbe recognizes only "legal" packets; it wasn't designed to examine illegal ones.

We performed one other test, which we are not reporting because industry experts disagree on its validity. We loaded an Ethernet network to 97 percent of its capacity with packets containing data fields of 1,514 bytes and an abnormal preamble of 2 bytes. It was impossible to get normal traffic through the network congestion, but because of the short preamble most of the products reported an empty network.

CONNECTIVITY

LAN ANALYZERS

Unix Protocols

PROTOCOL ANALYZERS

HP 4972A	802.2, 802.3, DSAP, SSAP
The LANalyzer Network Analyzer	802.3, IP, UDP
LANProbe	UDP
LANWatch	802.3, Internet, UDP
NetProbe	IP, UDP
Sniffer	DLC, IP, UDP, RPC, NFS
SpiderAnalyzer 320	IP, UDP, RPC, NFS

TRAFFIC COUNTERS

Emonitor+	N/A
Network Inspector	N/A
VigILAN	N/A

N/A—Not applicable: the product could not perform this test.

LAN Manager Protocols

PROTOCOL ANALYZERS

HP 4972A	802.2, 802.3, DSAP, SSAP
The LANalyzer Network Analyzer	802.3, XNS, IDP
LANProbe	XNS, SPP, SMB
LANWatch	802.3, XNS, IDP, SPP
NetProbe	IDP, SPP, 3Com, LSMB, PARAMS
Sniffer	DLC, XNS, SMB
SpiderAnalyzer 320	XNS

TRAFFIC COUNTERS

Emonitor+	N/A
Network Inspector	N/A
VigILAN	N/A

N/A—Not applicable: the product could not perform this test.

NetWare Protocols

PROTOCOL ANALYZERS

HP 4972A	802.2, 802.3, DSAP, SSAP
The LANalyzer Network Analyzer	IEEE, IPX, NCP
LANProbe	802.2, DSAP, SSAP, I-PDU
LANWatch	802.3, LLC, IPX
NetProbe	N/A
Sniffer	DLC, XNS, NCP
SpiderAnalyzer 320	IPX, NCP

TRAFFIC COUNTERS

Emonitor+	N/A
Network Inspector	N/A
VigILAN	N/A

N/A—Not applicable: the product could not perform this test.

Cable Open

PROTOCOL ANALYZERS

HP 4972A	N/A
The LANalyzer Network Analyzer	"Media open"
LANProbe	"Media bad"
LANWatch	N/A
NetProbe	N/A
Sniffer	"Open at 32 feet"
SpiderAnalyzer 320	"Open at 15 meters"

TRAFFIC COUNTERS

Emonitor+	"Media unterminated"
Network Inspector	"29-19 meters"
VigILAN	N/A

N/A—Not applicable: the product could not perform this test.

Bad Packets

PROTOCOL ANALYZERS

HP 4972A	☐
The LANalyzer Network Analyzer	☒
LANProbe	☒
LANWatch	☐
NetProbe	☐
Sniffer	☐
SpiderAnalyzer 320	☐

TRAFFIC COUNTERS

Emonitor+	☒
Network Inspector	☐
VigILAN	☐

■—Yes □—No

Forced Collisions

PROTOCOL ANALYZERS

HP 4972A	☒
The LANalyzer Network Analyzer	☒
LANProbe	☒
LANWatch	☒
NetProbe	☐
Sniffer	☒
SpiderAnalyzer 320	☐

TRAFFIC COUNTERS

Emonitor+	☒
Network Inspector	☒
VigILAN	☒

■—Yes □—No

Various protocol analyzers often use different terms to describe the contents of packets. A full explanation of these terms, the protocols, and their relationships is beyond the scope of this review, but here is a simple decoding of some terminology:

802.2 The IEEE protocol standard for Logical Link Control. When one analyzer reports what it sees in the "802.2 layer," this is the same data that another analyzer might report as "LLC."

802.3 The IEEE standard for an Ethernet-like packet. It contains two major parts conforming to the ISO's Physical and Data Link layers. The Data Link layer is divided into the Logical Link Control and Media Access Control sections. Each of these sections has further divisions.

DLC Data Link Control. A subset of the Logical Link Control protocol.

DSAP Destination Source Access Point. A subset of the LLC protocol.

IDP Internal Data Packet. A high-level data format.

IP Internet Protocol. IP software keeps track of the Internet addresses of nodes, routes outgoing messages, and recognizes incoming messages.

IPX Internetwork Protocol Exchange. A Novell protocol similar to specific layers of the Xerox Network Systems. Some analyzers recognize it as Novell-unique and others see it as XNS.

LLC The Logical Link Control protocol includes various subprotocols that control the priority and format of packets.

NCP NetWare Core Protocol. The message carried in the IPX packet.

NFS Network File System. A protocol based on IP and developed by Sun Microsystems.

RPC Remote Procedure Call. Used by HP, Sun

Microsystems, and others to standardize distributed computing procedures.

SMB Server Message Block. A protocol developed by Microsoft and IBM for client/server communications.

SPP Sequenced Packet Protocol. A subset of the XNS protocol used to send packets in an orderly fashion.

SSAP Source Service Access Point. A subset of the LLC protocol.

UDP User Datagram Protocol. This protocol describes how messages reach application programs within a destination computer. This is normally bundled with IP-layer software.

XNS Xerox Network Systems. A family of protocols developed by Xerox and widely used, at least in part, in network systems.

NOVELL INC.

The LANalyzer Network Analyzer

by M. Keith Thompson

The managers at Novell are a savvy group. Their bread-and-butter product is the *NetWare* family of operating systems. They enter a hardware field only when the market is ready to expand and the technology looks as if it can support the further growth of *NetWare*. Novell plunged into the market in a big way by buying Excelan Inc., reflecting the needs of a growing number of network developers and technically sophisticated administrators, many of whom are eager to see just how well their LANs perform. The LANalyzer Network Analyzer, priced at \$9,980, meets their demands.

Novell's new LANalyzer Products Division, formed from the core of the recently acquired Excelan, develops, manufactures, and markets products for network data collection, monitoring, analysis, and diagnosis. The LANalyzer evolved from the original \$50,000 Nutcracker developed by Excelan years ago. As microcomputer technology advanced, the Nutcracker shrank to portable computer size, along with its price.



FACT FILE

The LANalyzer Network Analyzer

Novell Inc., LANalyzer Products Division, 2180 Fortune Dr., San Jose, CA 95131; (800) 243-8526, (408) 434-2300.

List Price: \$9,980.

Requires: IBM PC AT or compatible with 640K RAM and 40MB hard disk; Ethernet, StarLAN, or Token-Ring network.

In Short: The LANalyzer, a complete LAN analyzer and monitor, decodes protocols for applications developers and sophisticated network managers alike. It also reports network activity in a variety of fashions, making it an excellent network monitor.

CIRCLE 619 ON READER SERVICE CARD

But the software is only as good as the hardware beneath it, so Novell powers it with a custom-designed Ethernet controller. The adapter uses a 10-MHz 80286 with 2MB of zero-wait-state tri-ported RAM. While an off-the-shelf controller is less expensive, this specialized controller boasts several significant advantages.

CONNECTIVITY

LAN ANALYZERS

THOROUGH TRAFFIC REPORTING

Standard LAN controllers purposely ignore certain types of events; therefore they miss some activity on the network. For example, in Ethernet topologies, standard controllers pay no attention to collisions that occur in the first 2 bytes of a packet. LAN analyzers that use these controllers won't see many kinds of shortened, interrupted, or otherwise damaged packets, leaving you where you were before you got the analyzers—in the dark. By contrast, the adapter used in the LANalyzer reports everything it sees to the software.

The LANalyzer
includes a rare feature:
it can replay packets
over the network.

The LANalyzer uses the 2MB of RAM as a series of on-board data buffers, storing captured packets there instead of in system memory. With ordinary adapters, as network speeds increase you stand to lose some data while waiting to transfer the bytes from the network to system memory. The LANalyzer's adapter moves data to the PC efficiently in every combination of network load and CPU we examined.

The LANalyzer provides a balanced set of features that identify, locate, and diagnose real network conditions and problems. Determining when to start capturing traffic and identifying what to capture is one of the most valuable features. The LANalyzer offers a complete set of triggering and filtering criteria. When searching for specific data, network managers want to see only the traffic of interest to them, not all the irrelevant packets, and these filters help to separate the important from the insignificant.

The latest version of the LANalyzer software does a good job of displaying and interpreting the messages contained in the various protocol levels of the packets it captures. But on a subjective level, our crew at PC LAN Labs felt that the screen display of the Sniffer (reviewed here) told us more about the function of a packet than the LANalyzer screen. Certainly, the

Sniffer gives you a more complete English-language interpretation of the packet functions. But the people who develop networked applications usually don't need this kind of translation. For them, the much lower price tag of the LANalyzer, together with Novell's backing, should make it a favorite choice.

The LANalyzer includes a rare feature that should be beneficial in many troubleshooting situations—the ability to replay packets over the network. While most analyzers permit you to examine captured packets on the screen, the LANalyzer plays them back over the LAN, so you can see how the changed information affects the application program. Before replaying, you can edit the packet stream to remove unneeded packets and elicit only the responses you want to see. This replay capability could save applications developers many hours of debugging time.

SCREENS AND SETUP

We found the LANalyzer screens and menus easy to use. The data capture and throughput screens include useful displays that show a histogram of network activity or allow you to view stations one by one.

Once you set all the filters, triggers, and other options, the software saves the settings in a test file with the extension .TST. The LANalyzer uses such test files to run automated tests on your network. Tests are run at a specified time, when a specific network event occurs, or manually whenever you wish. Novell includes DEFAULT.TST, a file that contains sample tests, so you can start monitoring your network with this product right out of the box and begin to accumulate data about its activity.

The LANalyzer software transfers the data it receives into a *Lotus 1-2-3* spreadsheet format through a Translate utility. Since data presentation style is often a matter of individual preference, network managers have complete flexibility to pipe data out to other popular graphing programs.

However the network administrators decide to use the LANalyzer's output, the product gives them a clear, concise view of their networks. It focuses on providing a balance of information, permitting fast analysis and prompt correction of real networking problems. Specialized hardware enables the LANalyzer to perform a complete set of LAN analysis functions, allowing network managers to monitor, diagnose, and troubleshoot multivendor LANs.



Laugh, sob, growl, warble, wail (or just talk) across your LANTastic PC Network.

The newest version of our LANTastic PC network has really got people talking.

You see, LANTastic is the first PC network to support Voice. So you can actually send voice messages from one PC to another across the LAN.

It's easy. Just pick up the telephone handset provided with the LANTastic Voice Adapter (sold separately at \$149* per adapter), bring up a handy menu, and talk. Use Voice Chat to carry on a realtime conversation or save the voice message in a digital format for playback later in your own voice—just like regular E-mail.

Only LANTastic has Voice. And Voice is just one of the reasons people are talking about LANTastic version 3.0.

Another is our new easy installation program that'll have you up and running in minutes.

And disk caching to boost network speed. Plus enhanced printing, E-mail, security and more.

All of which led PC Magazine to conclude:

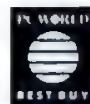
"LANTastic blows away the DOS-based competition in terms of performance."

—May 29, 1990

And don't worry. Even with all these new features, LANTastic still has the smallest RAM overhead of any network.

LANTastic version 3.0. Call 602-293-6363.

Developers. Artisoft offers a Voice Programmer's Interface so you can create your own "talking" software using the LANTastic Voice Adapter. Order it directly from Artisoft.



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SPIDER SYSTEMS

SpiderAnalyzer 320 SpiderMonitor 220

Burr-Brown Corporation

Spider Systems designs and markets the SpiderAnalyzer 320 and the SpiderMonitor 220—two protocol analyzers that like their namesakes manage to capture packets of data in intricately woven nets such as Ethernet and Token-Ring. Spider Systems' kits and complete units work on both of these topologies simultaneously and have prices starting at \$8,600. Spider Systems markets its products through VARs, sales representatives, and distributors alike.

The main difference between the two products is in performance and capability. The SpiderAnalyzer 320 is designed for the type of heavy-duty network analysis that developers and technical engineers perform. It provides sophisticated packet filtering and traffic generation capabilities, and with optional software decodes the seven-layer protocol stack. The bundled software decodes only up to layer 3 of the ISO stack, but Spider Systems provides optional decoders for AppleTalk, DECnet, NCP, TCP/IP, and protocols at \$750 each. In addition, the SpiderAnalyzer allows developers to write protocol decoders of their own devising.

You can save money by purchasing the SpiderMonitor 220. This product's less sophisticated filtering and traffic-generating capabilities target the average network manager. For the most part, these two products have the same capabilities (when we speak of the Spider, we are referring to both the analyzer and monitor.).

While most of the units in our reviews work on both Ethernet and Token-Ring networks, the Spider is the only unit that works on both topologies at the same time. Its software can communicate with both boards at once, monitoring both networks in real time. The software operates identically on the two topologies except where they logically differ. Installing the program is as simple as typing "A:INSTALL".

MODES OF OPERATION

The Spider has seven modes of operation, each suited to multiple network monitoring and analysis. The multitasking capability permits network managers to run other application software while the Spider

continues to monitor the network.

The Performance mode displays a histogram of current station-by-station network usage. Managers can view network load as a percentage of total available bandwidth or in packets per second.

**While most of the units
in our reviews work on
both Ethernet and
Token Ring networks,
the Spider is the only
unit that works on both
topologies at the same
time.**

The Statistics mode enables managers to display statistics for selected stations. Figures include packet count, byte count, errors per station, and total errors. The Statistics mode also allows managers to maintain a count of error packets and to display the errors.

In Summary mode, the network monitor and analyzer collect a history of average and peak loads and error rates over a set of user-defined time intervals. Time intervals can range from 1 minute to several hours, and the Spider can display the load numerically or in a graph.

The Spider provides four types of alarms in Alarm Summary mode: network load level exceeded, error level exceeded, new station on the network, or dead station. The software presents the alarms visually on the screen and audibly through the speaker while logging the alarm data to printer or disk.

The Test mode identifies opens or shorts in the cable using the time domain reflectometry (TDR) function. In addition, it tests lower-level transmissions with Echo and Loop Round tests using standard communications protocols.

The Traffic Generation mode does exactly as advertised: it generates traffic on the network. With the flexible packet count, size, and length, network managers

simulate the effect of adding a new application to an existing network. This can prevent many days of downtime that would be caused by overloading the network.

Finally, the Development mode filters and captures packets using predefined patterns and message types based on four filters of 64K each. This is where the rubber meets the road, because in this mode the network manager can set the triggers and extended filters to capture only the packets the manager is interested in monitoring.

The buffering feature, part of Development mode, captures up to 1,500 packets based on the four filtering options, or else captures to the hard disk as many packets as will fit. The network manager must determine beforehand when to start capturing traffic and must specify what to capture. The Spider offers them a good set of triggering and filtering criteria.

SOME STRENGTHS AND A WEAKNESS

The spreadsheet link to the Spider makes it easy for network managers to create informative reports with their favorite spreadsheet packages. These reports can show station error rates, traffic rates, and network usage.



FACT FILE

SpiderAnalyzer 320 SpiderMonitor 220

Spider Systems, 12 New England Executive Park, Burlington, MA 01803; (800) 447-7807, (617) 270-3510.

List Price: SpiderAnalyzer 320: kit, \$10,500; complete unit, \$15,600. SpiderMonitor 220: kit, \$8,600; complete unit, \$13,700.

Requires: 640K RAM.

In Short: Each of the Spider products is a top-notch protocol analyzer with good network management features. Companies requiring both Ethernet and Token-Ring topologies will benefit from the dual simultaneous monitoring.

CIRCLE 620 ON READER SERVICE CARD

Network managers can also monitor segments of the network across the campus or across the country. Like the Sniffer protocol analyzer from Network General, the Spider includes a remote monitoring capability. Each remote location requires a SpiderMonitor or SpiderAnalyzer along with the "slave" software. The "master" software runs on the network manager's computer and allows information displayed on the slave's screen to be seen on the master's screen as well. Therefore,

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CONNECTIVITY

LAN ANALYZERS

packets captured at the slave side can also be viewed by the network manager.

Overall, the SpiderAnalyzer 320 offers excellent flexibility at capturing packets. Unfortunately, during our tests, the Spider software ignored packets with short preambles. Even though lights on the adapter board clearly showed network traffic, the software reported that all was quiet. Packets with short preambles don't show up on networks every day, but if the card (and low-cost packages like *Emonitor+*) can see them, the software on higher-priced products should report them as well. Another problem that surfaced during testing occurred with the TDR system; the Spider identified a cable break at 45 feet when actually the cable was only 22 feet long. Admittedly, the other packages we reviewed also had trouble with cable testing.

The spreadsheet link
to the Spider makes it
easy for network
managers to create
informative reports.

Despite these drawbacks, SpiderAnalyzer fits in well in the network analyzer market. It decodes the full seven layers of the protocol's stack and is easy to use. The SpiderMonitor's limitations, on the other hand, indicate that it probably does not warrant its \$8,600 price tag. The LAN-analyzer Network Analyzer is only \$1,380 more and offers many more capabilities.

NetProbe

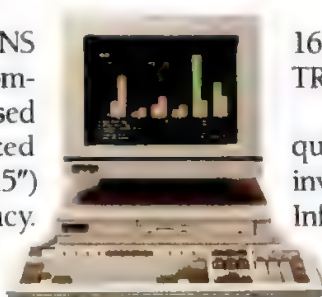
With 3Com's NetProbe

3Com understands the networking environment as well as anybody. Its *NetProbe* monitor utility, however, was designed with restricted scope. It is intended specifically to capture and decode packets on LANs using 3Com networking software, and it doesn't do much else.



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CONNECTIVITY LAN ANALYZERS

3Com offers two models of the *NetProbe*: *EtherProbe* for IEEE 802.3 Ethernet and *TokenProbe* for IEEE 802.5 Token-Ring networks. At \$995 each, these protocol analysis products fall at the bottom of the price/performance scale. The software doesn't include any measurement of network utilization, and its other features are limited as well.

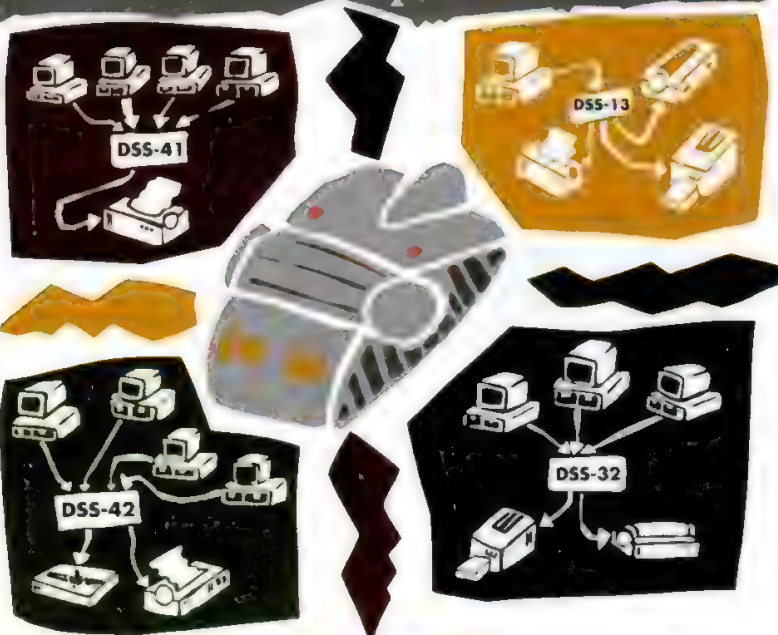
The *EtherProbe* utility supports all of 3Com's Ethernet adapters, while *Token-*

Probe runs on 3Com and IBM 4-megabit Token-Ring cards. *NetProbe* decodes AppleTalk, SMB, TCP/IP, and XNS protocols. For this review we concentrated on the Ethernet packages and did not test the *TokenProbe* software.

You won't need to spend much time installing and setting up *NetProbe*. That process is quick and easy. 3Com provides a

sample CONFIG.SYS file that includes the four lines necessary for proper operation. Once you have the device drivers in your CONFIG.SYS file, typing EPROBE starts the program. If you prefer, you can change the default configuration at load time with command line parameters. For example, the "-P & -D" parameters, in association with a filename, change the default save and station name files, respectively. Once you have the program running, the function keys guide you through its menus.

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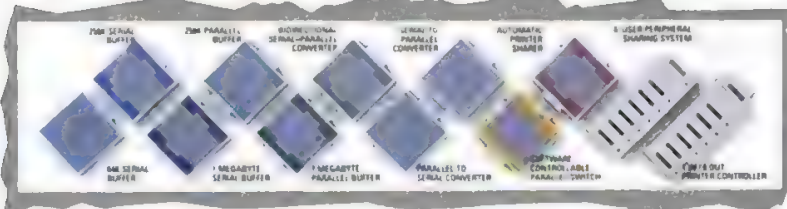
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CIRCLE 726 ON READER SERVICE CARD

To help you capture only the packets of interest, *NetProbe* includes filtering commands that let you select traffic from any one location.

Like other protocol analyzers, *NetProbe*'s main function is to capture and display packets received over the network. The program holds up to 200 packets in its buffer, and when the buffer is full, *NetProbe* replaces older packets with newer ones.

SELECTIVE PROBING

To help you capture only the packets of interest, *NetProbe* includes both filtering and triggering commands. The Filter command lets you select traffic from any one location, or to and from any two nodes. Another filtering option selects only one type of Ethernet service.

The Trigger command specifies when to start capturing and how many packets to capture. In the first level of triggering options, you choose the portion and type of packet that will trigger the capture command. Go one level lower and you decide exactly when to start capturing data by selecting the appropriate bits in the packet. Once you get to the bit level, *NetProbe* provides a fairly thorough set of selection rules.

One of *NetProbe*'s conveniences is that instead of displaying the 12-digit Ethernet

They Left out Features.... We Left out the **COMMA!!**

The only thing missing...

is the comma in the price. If you look at the chart on the right you will see prices charged by our competition. All but one contain a comma. **DesignCAD 3D** sells for \$399.00. Period. No Comma!

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Source: Byte Magazine

BYTE MAGAZINE SAYS...

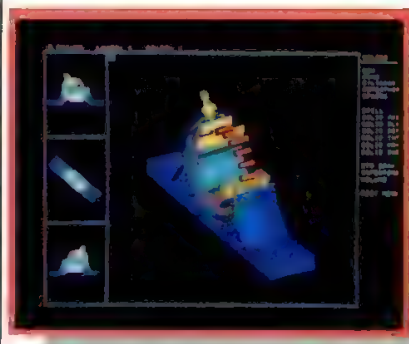
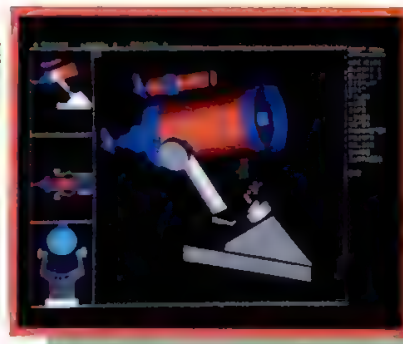
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DesignCAD 3-D and **DesignCAD 2D** are available from most retail computer stores, or you may order directly from us. If you have questions about which program to purchase please give us a call. All you need to run **DesignCAD 3-D** is an IBM PC or compatible computer with 640 K RAM memory and a hard disk. Both products support most graphics cards, printers, plotters and digitizers. Free information and a demo disk are available by faxing (918) 825-6359 or telephoning:

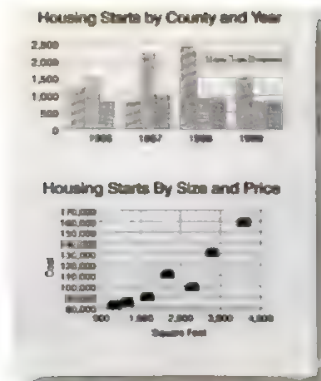
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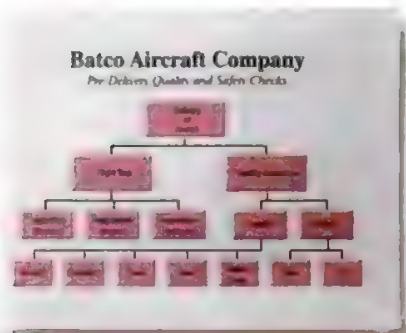
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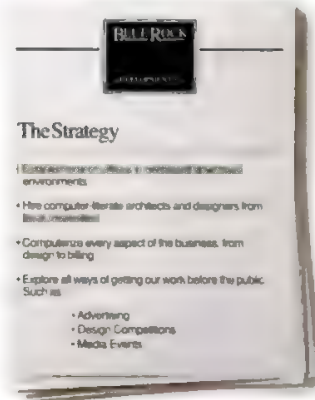
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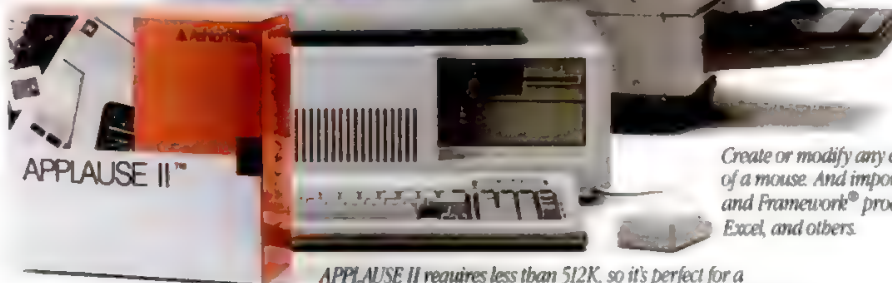
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CONNECTIVITY

LAN ANALYZERS

NetProbe provides you with an overview of your network, but it does not include many simple features found in network monitoring programs.

address for each workstation, it displays a user name from a custom name table. The table contains two additional fields for information—a 12-character station name and one of four station types. This makes it easier to understand the flow of traffic on the network.

With the Look command, *NetProbe* displays the captured data in a variety of different views. The summary view shows the source, destination, and type of the packet. The detail view decodes the packet and displays the information in an easy-to-understand English format. If the packet contains more data than you can display on the screen at once, *NetProbe* displays only the first and last several bytes.

Thus, *NetProbe* does provide you with an overview of your network, but unfortunately it does not include many simple features found even in network monitoring programs. As indicated in our Summary of

Features table, it neither counts nor recognizes nonstandard, short, or bad CRC packets, nor displays throughput, nor shows you the amount of network utilization. 3Com designed *NetProbe* specifically for companies running 3+Share or 3+Open LAN Manager operating systems, and it performs its limited functions well on those systems.

TIARA COMPUTER SYSTEMS INC.

Network Inspector

by Kimberly Maxwell

Network Inspector doesn't need a magnifying glass to inspect network activity, monitor network traffic, and gather statistics about a workstation or the entire network. The \$1,495 package, available from

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FACT FILE

NetProbe, Version 2.2

3Com Corp., 3165 Kifer Rd., Santa Clara, CA 95052-8145; (800) 638-3266, (408) 562-6400. List Price: \$995.

Requires: IBM PC, AT, PS/2, or compatible (AT recommended) with 640K RAM; EtherLink, EtherLink II, EtherLink MC, EtherLink Plus, or 3Com 3Station for Ethernet, or 3Com TokenLink for Token-Ring; DOS 3.1 or later.

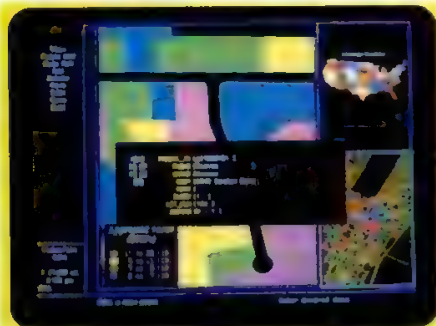
In Short: Designed for 3+Share and 3+Open LAN Manager networks, *NetProbe* superficially analyzes the network traffic. While it is much less expensive than a true LAN analyzer, *NetProbe* lacks many of the features found in programs costing less than half as much.

CIRCLE 621 ON READER SERVICE CARD

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CONNECTIVITY LAN ANALYZERS

Tiara Computer Systems, requires a Tiara Ethernet card.

The menu-driven *Network Inspector* works with any network operating system, including Novell's widely used *Advanced NetWare 286*, Version 2.0a or later, and *NetWare 386*. If you are using *NetWare*,

Network Inspector tells you the type of adapter cards found in each workstation on your network.

the IPX/SPX drivers included with *Network Inspector* let you perform specific single-station echo tests and view the results. The program can provide information about one workstation or the entire network you are monitoring. It is also able to locate cable breaks and problems with hardware and tell you the high-usage times on your network.

Installation is quick. You copy the *Network Inspector* files into a directory on a workstation designated for network monitoring functions, load drivers for the Tiara card into your network operating system, and insert your Tiara Ethernet card into your machine. Elementary. You must use one of the compatible Tiara Ethernet cards, because no other cards work with the program; Tiara cards have a special controller chip on-board that *Network Inspector* needs to perform its task. The 16-bit Tiara Ethernet card we tested sells for \$499.

Network Inspector runs on any network PC. You should make sure that the program is installed on a single local area network, not on networks that have been bridged. You can, however, use the program on a network that includes transparent repeaters, which carry signals across extended cables between distant workstations.

When you begin to use the program, there will be several times when you're asked for a workstation ID or address. Therefore, it is important to jot down the Ethernet node IDs before you start to work with the monitoring software. The soft-

ware won't help you find those IDs during its installation process.

ON FURTHER INSPECTION

Network Inspector is simple to use. When you begin to monitor your network, you will notice three choices in each menu selection. You move through the bar menus until you have reached a section of statistics that you want to view on your screen.

If you select the Network Statistics screen, you'll see three horizontal bar graphs showing the frames per second, the number of stations on your network, and the percentage of network utilization. The screen also shows you number values for CRC errors, elapsed monitoring time, short frames, and frame alignment.

Should you wish to monitor an individual workstation's activity, *Network Inspector* asks you for a node ID number. Again, it doesn't offer any help, so you must know the number ahead of time. The Individual Statistics Collection screen is similar to the Network Statistics screen,



FACT FILE

Network Inspector, Version 1.0
Tiara Computer Systems Inc., 2700 Garcia Ave., Mountain View, CA 94043; (415) 965-1700.
List Price: \$1,495.
Requires: 10-MHz 286 PC (IBM PC AT or PS/2 Model 30 with 640K free RAM recommended); Tiara 16-bit Ethernet adapter card (\$499); *Advanced NetWare 286*, Version 2.0a or later, or *NetWare 386*; DOS 3.1 or later.
In Short: *Network Inspector* efficiently monitors your workstation or network. You don't need an in-house technical expert to set up or use the program, but you will need the Tiara Ethernet card, and the total cost is not competitive.

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displaying three bar graphs, number values, and the percentage of network utilization. The program also shows information on the packets going to and from each station and on multistation network broadcasts.

Network Inspector includes diagnostic tools that provide information about the hardware on the system. The TDR (time domain reflectometer) detects breaks in a coaxial cable within a 10-meter range. The program also tells you the type of adapter cards found in each workstation on your network.

Calling up FrameView on the menu in-

vokes a frame-monitoring utility that captures frames directly from the network media using simple filters like origination address, destination address, and packet type. It then displays the captured frame data for your analysis and shows you all the ASCII and hex code it finds, without

Network Inspector gives you a wealth of analytical information about the network or workstation you are monitoring. But you need a Tiara Ethernet card to run it.

translation or evaluation. *Network Inspector* saves as many data frames as it can fit in a buffer, and the number of buffers depends on the amount of memory in the workstation. We found the manual and help screen of little assistance in setting up collection criteria to be used in the Frame-View facility.

If you have any difficulty interpreting a task, or if you need to know a little more about the selection you have chosen, you should try invoking the help facility by pressing the F1 key and checking the brief descriptive statement it provides you. Minor problems can sometimes be resolved by consulting a selection called Program Information, which reports on the *Network Inspector* configuration. A troubleshooting section in the manual may also help.

Network Inspector gives you a wealth of analytical information about the network or workstation you are monitoring. But you need a Tiara Ethernet card to run the program, and the total cost is simply not competitive with other software packages that have similar features. ■

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine. Kimberly Maxwell and M. Keith Thompson and frequent contributors to PC Magazine.

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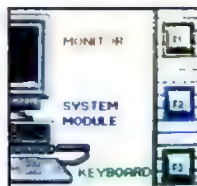
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Flat-File Databases

Fast Answers To Easy Questions

It wasn't too long ago that PC power users scoffed at flat-file databases. As an alternative to powerful programmable database managers that were too unwieldy

for nonprogrammers, flat-file packages demanded less computer savvy but unfortunately provided fewer capabilities than their more-sophisticated brethren.

Flat-file databases didn't force users to learn a plethora of obscure commands—they offered the simplicity of selecting from menu options.

PC-File, Professional File, Q&A, RapidFile, Reflex, and Superbase 2 prove that database management systems don't need to be programmable (or expensive) to be powerful.

They also made it easy to find records and generate reports quickly without waiting for someone to write a customized program. Rather than sorting and indexing multiple tables, most flat-file packages simplified data management by storing everything in two-dimensional tables that contained a few dozen fields and a few hundred records. In short, they didn't differ all that much from spreadsheets and were only a little more powerful when it came to database functions.

By Richard Hale Shaw

ENCOURAGING PROGRESS

Flat-file databases like the six we evaluate here, *PC-File*, *Professional File*, *Q&A*, *RapidFile*, *Reflex*, and *Superbase 2*, have come a long way and now operate quite comfortably on thousands of records. They produce complex reports at a moment's notice, sport spreadsheetlike functions for data manipulation and transformation, and can import and export a variety of file formats. Some offer the ability to look up data in other tables, and for others, like *PC-File* and *Reflex*, generating instant graphs is de rigueur. The beauty of all this is that flat-file packages still remain easier to use than programmable databases.

Of course, flat-file databases strongly differ from programmable systems like *Paradox* and *dBASE IV*. Since programmable DBMSs are principally designed for developers who write custom applications to solve large database problems, their primary interface is programming languages. Programmable packages can manage multiple files simultaneously, are optimized for the manipulation of large files with upwards of 50,000 records, and offer strong LAN support. Most cost between \$400 and \$1,000.

Flat-file systems, on the other hand, are really disk-based spreadsheets used by people concerned with output, not application customization. Rather than providing fancy file-handling and programming ability, flat-file databases focus on fast reporting, labeling, mail-merging, and in some cases, graphing. They cost less than their programmable cousins, too, from a little over \$100 to \$400.

Improvements in these packages have coincided with a general improvement in software technology itself. Since *PC Magazine's* last flat-file roundup ("Flat-File Databases: Easy-to-Use Sophisticates," April 12, 1988), *Microsoft Windows* and other graphical user interfaces (GUIs) have strengthened their position in the marketplace, and many intuitive, easier-to-use software packages have arrived. Of the six data managers here, *Reflex* and *Superbase 2* have changed significantly and now take advantage of a graphical interface. *PC-File* has also been broadly revamped, although it continues to be character-based as do *Professional File*, *RapidFile*, and *Q&A* (which won Editor's Choice in the last roundup). These last three have seen only incremental changes in the last two years, although more significant releases should be forthcoming by the end of this year.

Most of these data managers offer numerous import and export facilities, but only *Superbase 2* and *PC-File* have the ability to directly read and update the files of a major programmable DBMS like *dBASE III Plus* or *dBASE IV*. *PC-File*, *Q&A*, and *Professional File* also offer some form of useful network support. Other subtleties: *Q&A* integrates a full-featured word processor, and *Professional File* sports a simple application generator.

FLAT-FILES IN THE NINETIES

Despite the increasing usability of flat-file databases, they may become an endangered species. As spreadsheets like *Microsoft Excel* add facilities for database access and dynamic data exchange (DDE) links to word processors like *Microsoft Word for Windows*, they'll offer the best features of flat-file databases and more.

With the right improvements, however, these low-end data managers can become the primary end-user workstation tool of the nineties. To do so, they'll all need to incorporate GUIs with multiple, simultaneous views of data, and faster, more-powerful, and even easier-to-use querying and reporting capabilities. Data graphing and full PostScript support will become commonplace; crosstabs, spreadsheetlike functions, and full multiuser network compatibility with auto-refresh will need to be part of the package.

Flat-file users don't want to know how a data manager stores and manipulates data; they just want to access it transparently in popular formats without importing. Nonstandard, proprietary file formats must be banished. And while these data managers needn't be relational (even a good relational DBMS uses views to make related tables look like a single flat file), they will need to manipulate *dBASE* and *Paradox* files, as well as databases accessed through SQL. There is a future for flat-file databases, but only if they keep pace with the competition.

PC-File

With the ability to edit, query, graph and generate reports from your *dBASE* files, *PC-File*, Version 5.0, comes up a low-cost winner. At only \$129.95, ButtonWare's shareware flat-file database boasts a character-based interface with intuitive pop-up menus that novices can under-



EDITOR'S CHOICE

- PC-File
- Reflex

Though we still hold our previous Editor's Choice, *Q&A*, in high esteem, two flat-file databases that have recently been upgraded offer a combination of features and values that, for the price, make them stand out, at least until the next version of *Q&A* arrives.

Reflex, Version 2.0, offers an impeccable interface, gorgeous graphs, multiple views of a file, and good performance to boot. Anyone can use it, and with a little effort it does an outstanding job of generating reports, labels, and mail-merge letters. At \$249.95, *Reflex* is a model for flat-file databases of the nineties.

PC-File, Version 5.0, doesn't offer all the features you can find in *Reflex*, but it does have superb graphing and multifile reporting facilities. It's also completely file-compatible with *dBASE III Plus*. This gives it an edge over every other flat-file package and allows it to serve as a real alternative to *dBASE*. While it's slightly handicapped by its slower speed, you can try it before you buy it (it's available as shareware), and at \$129.95, it's a terrific value.

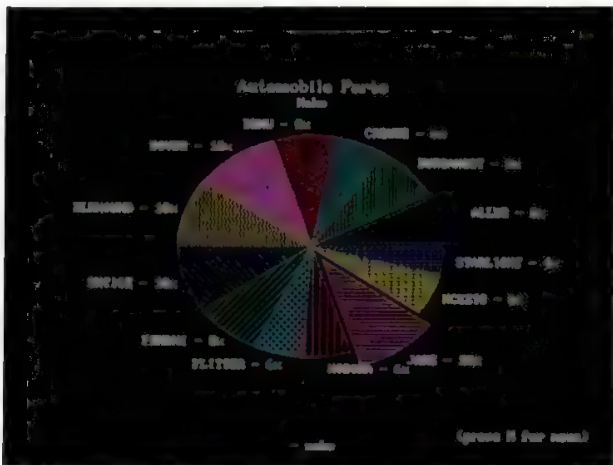
Finally, an honorable mention goes to *Superbase 2*. It offers an excellent interface, which upcoming *Microsoft Windows*-based versions of the other flat-file packages will flatter through imitation. With DDE facilities, the ability to display attached text and graphics files, and complete compatibility with its programmable relational sibling (*Superbase 4*), it offers a good look into the future of flat-file databases.

stand. It even has mouse support, although it tends to be too movement-sensitive.

Compatible with *dBASE III Plus* files, *PC-File* maintains an additional file for each database to store field positions, the database description, and the currently selected index, and it offers considerable support for complex, user-definable indexes. Even some indexing functions like the descending keys and soundex (phonetic) indexing that are not supported by

dBASE III Plus are available here. And as in *Superbase 2*, there's no way to open an unindexed view of a file.

Like *Reflex*, *PC-File* offers graphing capabilities (the fact that there are only two in the flat-file category isn't surprising. Only two programmable databases are known for their graphing: *FoxBase* and *Paradox*). *PC-File* differs from *Reflex* in that it passes the graph parameters



PC-File is one of only a few low-cost flat-file database packages that lets you generate instant graphs, including pie, line, bar, and scatter graphs.

to a separate executable program that can be run from the DOS prompt, which means you can save graph parameters to a file and later run the graphics module from another application or a batch file.

PC-File sports some graphics features that even *Reflex* doesn't have, such as the ability to extract a wedge from a pie chart, dynamically draw grid lines over the chart, or use a single command to exchange the variables used on different axes. The program can output a PostScript version of the graph to a disk file or printer, switch between logarithmic and arithmetic scales, and dynamically draw averages and smoothed (moving) averages over bar charts.

HANDY EXTRAS

There are some other nice touches. The file browser automatically switches to 43- and 50-line EGA or VGA mode if it can. Special keys are available to temporarily store and recall data, duplicate the previous record, and print labels (you can choose from 14 predefined types, including three-across labels). There's even an auto-dialer that dials a phone number from the current record. You can define keyboard macros (even recursive macros), and you can store individual screen and printer settings in a profile for each database. Window fields can be defined if the dis-

played length is shorter than the length of the field. Simple file lookups into other databases are allowed in queries and reports.

PC-File offers a simple one-line pop-up calculator and lets you use calculations in reports and expressions. In addition to the usual arithmetical operations, it sup-

ports modulo—unusual, but useful for an end-user program.

You can create reports by "painting" a free-form format or by following the program's prompts for the information it needs. Alternatively, a small report language is available for both reports and mail-merge, giving you the ultimate control over the report and output.

A network version of *PC-File* is available for \$349.95 and its file- and record-locking capabilities protect you from having more than one user simultaneously update the same record.

Although nicely priced and easy to use, *PC-File* is not a stellar performer. On

the *PC Magazine* database benchmark tests, its import and sort times placed it in the middle or low end of the pack. Its extract, search, global change and report times were often the slowest, particularly on larger (500 to 5,000 record) database files.

That issue aside, its full *dBASE III Plus* file and index compatibility may make *PC-File* a program that you can't do without. It doesn't run your *dBASE* applications, but it does provide a low-cost, powerful alternative to buying multiple copies of *dBASE*. We'd love to see a GUI version of this package in the future—it would be a real killer.

Professional File

Software Publishing's *Professional File*, Version 2.01, is one of the original flat-file databases. Using a character-based interface with pull-down menus, this \$299 package offers a forms-based approach to data management. Anyone familiar with *Q&A* will be surprised at the resemblance between the base command set and menu options in these two programs. (Note: *Professional File* came first).

Building a database requires that you create a new form, including field information. You can add field attributes, which specify indexed fields, display lengths, formats, and even field formulas. You fill in the form to search for and update records, select sort fields or records for review, and generate reports. There are a number of special keys to facilitate the use of forms: one duplicates the previous record, another copies the current field from the previous record, and yet another inserts the date into a field.

The program allows data validation lookups from other files, including those created with *dBASE III Plus*. As in *Superbase 2*, you can read and query *dBASE* files and use them in reports, but you can't update them without importing them first. *Professional File*'s limitation of 59,000 records in a database also limits the file imports and lookups: it can only look at 59,000 records in a *dBASE* file. While this limitation may not be important to some flat-file users, it severely handicaps those who want to interact with other applications. *Reflex* and *RapidFile*, which let you access 65,000 records, are only a little less-hampering in this respect. *Q&A* and *Superbase*, on the other hand, let you

FACT FILE
EDITOR'S CHOICE

PC-File, Version 5.0
 ButtonWare Inc., P.O. Box
 96058, Bellevue, WA
 98009. (800) 528-8866,
 (206) 454-0479.
 List Price: \$129.95.
 network version, \$349.95.
Requires: 512K RAM.
 DOS 2.0 or later.
In Short: A low-priced, powerful, feature-
 packed and easy-to-use *dBASE*-compatible
 package with graphics, mouse support, and
 good report, label, and mail-merge facilities.



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SOFTWARE FLAT-FILE DATABASES



FLAT-FILE DATABASES: SUMMARY OF FEATURES

Products listed in ascending price order

	PC-File \$129.95	Reflex \$249.00	RapidFile \$295.00	Superbase 2 \$295.00	Professional File \$299.00	Q&A \$349.00
FILE-STRUCTURE LIMITS						
Number of characters per field	254	8,000	254	4,000	1,680	1,678
Number of fields per record	128	250	250	Unlimited	3,200	2,182
Record size	4,000	8,000	7,500	Unlimited	56,300	16,780
Number of records per data file	1 billion	65,000	64,000	16 million	59,000	16 million
Number of data files per database	1	1	1	1	1	1
NUMERIC DATA TYPES AND SIZES						
Fixed-point decimal	■	■	■	■	■	■
Integer	■	■	■	■	□	□
Long integer	■	■	□	■	□	□
Currency	□	■	□	■	■	■
Floating-point	□	■	□	■	□	□
FIELD ATTRIBUTES						
Range testing	□*	□*	□*	■	■	■
Default values	■	■	□*	■	□*	■
Specific value requirement	□*	□*	□*	■	□*	■
External data table look-ups	■	□	□	■	□*	■
Double entry verification	□	□*	□	□	□*	■
Fill field	□	□*	□	■	□*	■
Forced uppercase	■	□*	□	■	□*	■
Date conversions	■	□*	□*	■	□*	■
Unique fields	□*	□*	□	■	■	■
Automatic data entry	■	■	■	■	□*	■
Calculated fields on entry screen	■	■	■	■	□*	■
Carryover from previous record	■	■	■	■	□*	■
Error handling	□*	■	■	■	■	■
DATA IMPORT AND EXPORT						
ASCII	■	■	□	■	■	■
User-definable delimited ASCII	■	■	■	■	■	■
.DBF	■	■	■	■	■	■
.DB (Paradox)	□	■	□	□	□	□
.DIF	■	■	□	■	□	■
.PFS	■ (export only)	■ (import only)	■	□	■	■ (import only)
SYLK	■ (export only)	□	□	□	□	□
.WKS/.WK1	□	■	■	■	■	■ (import only)
.XLS	□	□	□	■	□	□
INDEXING						
Compound indexes	■	□	□	■	■	■
Index values need not be unique	■	■	■	■	■	□
Can respecify indexed field(s)	■	□	□	■	■	■
Can respecify file definition	■	■	■	■	■	■
Multiple record deletions	■	■	■	■	■	■
Multiple record updates	■	■	■	■	■	■
Math updates	■	■	■	■	■	■
Text updates	■	■	■	■	■	■
Table merging	■	■	■	■	■	■
Minimum number of open files	1	0	1	0	0	0
Maximum number of open files	128	1	1	Unlimited	1	1
SORTING						
Ascending order	■	■	■	■	■	■
Descending order	■	■	■	■	■	■
Macros	■	□	■	■	■	■
Mouse support	■	■	□	■	□	□
INPUT FACILITIES						
Prompt messages for fields	■	■	□	□	■	■
Number of screens per file	5	Unlimited	1	1	1	10
Number of files per screen	1	1	1	1	1	1

* This feature is attainable through programming.

□—Editor's Choice ■—Yes □—No

CONTINUES



FLAT-FILE DATABASES: SUMMARY OF FEATURES

Products listed in ascending price order

	PC-File \$129.95	Reflex \$249.00	RapidFile \$295.00	Superbase 2 \$295.00	Professional File \$299.00	Q&A \$349.00
OUTPUT FACILITIES						
Multifile reports	☒	☐	☐	☒	☐	☒
Standard deviation	☒	☒	☐	☐	☐	☒
Variance	☒	☒	☐	☐	☐	☒
GRAPH FUNCTIONS						
Bar chart	☒	☒	☐	☐	☐	☐
Pie chart	☒	☒	☐	☐	☐	☐
Line chart	☒	☒	☐	☐	☐	☐
Range parameters	☒	☒	☐	☐	☐	☐
Report definition method:						
Painting	☒	☒	☒	☐	☐	☒
Forms duplication	☒	☒	☒	☐	☒	☒
Automatic	☒	☒	☒	☐	☒	☒
Predefined mailing labels	☒	☒	☒	☒	☒	☒
Programming	☒	☒	☐	☐	☒	☒
Stored report definitions	☒	☒	☒	☒	☒	☒
Headers	☒	☒	☒	☒	☒	☒
Footers	☒	☒	☒	☐	☒	☒
Printer setup facility	☒	☒	☒	☒	☒	☒
QUERY FACILITIES						
Multifile access	☒	☐	☐	☒	☐	☒
Stored queries	☐	☒	☒	☒	☒	☒
SEARCH PARAMETERS						
First occurrence	☒	☒	☒	☒	☒	☒
All occurrences	☒	☒	☒	☒	☒	☒
Index field only	☐	☐	☐	☐	☐	☐
Multiple fields	☒	☒	☒	☒	☒	☒
Case sensitive	☒	☒	☐	Optional	☐	☒
Whole word searches	☒	☒	☒	☒	☒	☒
Range searches	☒	☒	☒	☒	☒	☒
Phonetic searches	☒	☒	☐	☒	☐	☒
BOOLEAN SEARCHES						
AND	☒	☒	☒	☒	☐	☒
OR	☒	☒	☒	☒	☒	☒
NOT	☒	☒	☒	☒	☒	☒
SPECIAL FEATURES						
Applications generator	☐	☐	☐	☐	☒	☐
Menu generator	☐	☐	☐	☐	☒	☒
Customizable keyboard	☐	☐	☐	☐	☐	☒
Customizable color screen	☒	☒	☒	☒	☒	☒
SUPPORT						
Context-sensitive on-line help	☒	☒	☒	☐	☒	☒
Tutorial included	☒	☒	☒	☒	☒	☒

☐ —Editor's Choice ☒ —Yes ☐ —No

ENDS

access 16 million records, and *PC-File* goes to one billion.

Other *Professional File* features include crosstab support (the only flat-file database other than *Reflex* to do so), keyboard macros, modest report, and a mailing-label support .EXE file, which you can run from the DOS prompt.

PROFESSIONAL CUSTOMIZATION

While the documentation claims that you can create customized applications with

Professional File, what this really means is that you can load *Professional File* with a customized front end. The front end can contain a series of help screens, error messages, and custom menus. The latter can use any of the main program's menu commands, and run previously saved reports and labels or other customized applications. This is particularly important if you want to access another database, as each custom application is tied to its own database.

Although it's not as flexible or powerful as I would like, *Professional File* lets you automate routine tasks, hopefully reducing the learning curve for new users. You can further customize your database by applying password protection, thus limiting the number of users who can access it. Unfortunately, only one user at a time can run a customized application on a network unless you are willing to create multiple copies and run them from different network directories.

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Crosstalk Communications ... NCP

2908 ☐ **Crosstalk XVI 3.7** 119.
 5611 ☐ **Crosstalk for Windows 1.0** 129.

Data Storm ... NCP

4798 ☐ **PROCOMM PLUS 1.1** 52.

Delrina Technology ... NCP

4325 ☐ **PerFORM 2.1 (\$30 rebate!)** 159.

Delta Technology ... NCP

5829 ☐ **Direct Access 5.0** 52.

Digital Composition Systems ... NCP

5876 ☐ **db Publisher Report Maker 2.0** . 185.

Dow Jones ... NCP

5494 ☐ **News/Retrieval Membership Pkg.** 24.
 6879 ☐ **Market Analyzer 2.01** 225.
 6880 ☐ **Market Analyzer Plus 2.0** 325.

5th Generation ... NCP

2762 ☐ **Mace Utilities 1990** 89.
 3950 ☐ **Fastback Plus 2.1** 109.

FormWorx ... NCP

5810 ☐ **FormWorx with Fill & File 2.5** 85.

Fox Software ... NCP

6188 ☐ **FoxPro 1.0** 489.
 2233 ☐ **Foxbase Plus 2.1** 199.

Funk Software ... NCP

2228 ☐ **Sideways 3.21** 42.
 4479 ☐ **Allways 1.2** 115.

Generic Software ... NCP

2265 ☐ **Generic CADD Level 3 1.1.3** ... 225.

Great American Software ... NCP

4880 ☐ **One Write Plus Accounting Sys. 2.06** 179.
 5825 ☐ **Money Matters 1.0** 55.

Harvard Associates ... NCP

2324 ☐ **PC Logo 3.0** 59.

Hilgraeve ... NCP

2323 ☐ **HyperACCESS/5 1.0 (DOS & OS/2)** 115.

IBM ... NCP

6187 ☐ **Storyboard Plus 2.0** 239.
 6599 ☐ **Current 1.0** 239.

Bloc Publishing ... NCP

6546 ☐ **Disk Vision 1.1** 45.
 1447 ☐ **FormTool 2.01** 55.

6245 ☐ **PopDropPLUS 1.0** 59.

6012 ☐ **Print Rite 1.3** 59.

Borland International ... NCP

4330 ☐ **Turbo C Professional Pack 1.0** ... 175.

4332 ☐ **Turbo Pascal Professional Pack 1.0** 175.

6242 ☐ **Quattro Pro 1.0** 325.

1514 ☐ **Paradox 3.0** 469.

Brightbill-Roberts ... NCP

5408 ☐ **Hyperpad 1.0** 85.

Broderbund ... CP

1434 ☐ **New Print Shop (NCP)** 39.

1433 ☐ **Memory Mate 3.01 (NCP)** 45.

ButtonWare ... NCP

6419 ☐ **PC-File 5.0** 75.

Caere ... NCP

6004 ☐ **OmniPage 386 2.1** 599.

Central Point ... NCP

5039 ☐ **PC Tools Deluxe 6.0** 89.
 5038 ☐ **Copy II PC 5.0** 27.



Corel Systems ... NCP

☐ **CorelDRAW! 1.2**—The world's finest PC illustration software now comes with even more value: CorelTRACE, over 100 type-faces, over 300 clip-art images, a Pantone license—all bundled in for free \$329.

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Individual Software ... NCP

2408	□Professor DOS 4A	\$27.
6222	□Resume Maker 1.0	29.
Intuit ... NCP		
2426	□Quicken 3.0	39.
LaserTools ... NCP		
6882	□PrintCache 2.2	99.
Lord Publishing ... NCP		
5191	□Ronstadt's Financials 1.02	75.
Lotus ... NCP		
5417	□1-2-3 3.0	call
5653	□1-2-3 2.2	call
5134	□Magellan 2.0	119.
4131	□Agenda 1.0	275.
2660	□Freelance Plus 3.01	345.

MECA ... NCP

2798	□Managing Your Money 6.0	119.
7002	□Home Lawyer 1.0	69.
Microcom ... NCP		
6234	□CarbonCopy Plus 5.2 (2 req.)	115.
Micrografx ... NCP		
6294	□Draw Plus 1.0	289.
Micro Logic ... NCP		
2968	□Tornado 1.8	55.
6787	□Info Select 1.1	55.

Microlytics ... NCP

2731	□GOfier 2.0	45.
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Microsoft ... NCP

2860	□Learning DOS 2.0	35.
2899	□Windows 286 2.11	69.
2904	□Works 2.0	99.
2901	□Word 5.0	209.
6195	□Word for Windows	329.
2856	□Excel 2.1 (req. 80286/80386)	call
6133	□Excel for OS/2 1.0	339.
5188	□QuickPascal 1.0	55.
2894	□QuickBASIC 4.5	69.
2895	□QuickC 2.0	69.
2853	□C Compiler 6.0	339.

Multisoft ... NCP

6805	□PC-Kwik Power Disk 1.0	49.
4925	□PC-Kwik Power Pak 1.5	79.

Nolo Press ... NCP

2982	□WillMaker 3.0	35.
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Norton-Lambert ... NCP

4928	□Close-Up Customer 3.0	\$135.
4929	□Close-Up Support 3.0	165.

Paperback Software ... NCP

6358	□VP-Planner 3D 1.0	155.
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PC Globe ... NCP

5902	□PC Globe 3.0	39.
5900	□PC USA 1.0	39.

Personics ... NCP

3126	□SeeMORE 2.0	54.
4328	□Look & Link 1.1	59.
4384	□Ultravision 2.0	79.

Peter Norton ... NCP

3152	□Norton Commander 3.0	99.
3146	□Advanced Utilities 4.5	99.
6397	□The Norton Backup 1.0	99.

Precision Software ... NCP

6600	□Superbase 4 for Windows	449.
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Quarterdeck ... NCP

6422	□QRAM 1.0	49.
3221	□Expanded Memory Mgr. 386 5.0	59.
3220	□DESQView 2.26	79.
4586	□DESQView 386 1.1	129.
6400	□Manifest 1.0	39.



Microsoft ... NCP

□Word for Windows—Combines the power of Word for the PC with ease of use and WYSIWYG accuracy of Microsoft Windows. Integrate graphics and data from Windows applications into your documents... \$329.

3542	□Software Carousel 3.01	55.
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Software Publishing ... NCP

3499	□PFS:First Publisher 3.0	99.
3478	□PFS:First Choice 3.02	105.
3496	□Professional Write 2.12	149.
3493	□Professional File 2.01	199.
3482	□Harvard Graphics 2.13	339.
6289	□Draw Partner 1.0 (for Harvard Graph.)	59.

Symantec ... NCP

3412	□Grandview 1.0	199.
3425	□Q&A 3.0	229.
3431	□Timeline 4.0	469.

Systems Compatibility ... NCP

6564	□Software Bridge 4.1	79.
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TIMESLIPS ... NCP

2987	□Timeslips III 3.4	169.
6994	□PercentEdge 1.0	69.

Timeworks ... NCP

6253	□Publish-It! 1.1	115.
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TOPS ... NCP

6675	□TOPS Network Bundle 3.0	159.
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Multisoft ... NCP

□PC-Kwik Power Pak 1.5—Tremendous performance improvement. Includes award-winning Super PC-Kwik, RAM Disks, Print Spoolers, Screen Accelerator (with ReView & screen blanking), & Keyboard Accelerator... \$79.

Reality Technologies ... NCP

6572	□WealthBuilder 1.01	145.
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Reference Software ... NCP

4396	□Grammatik IV 1.0	52.
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Revolution Software ... NCP

4480	□VGA Dimmer 2.01 (screen saver)	19.
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RightSoft ... NCP

4155	□RightWriter 3.1	54.
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Samna ... NCP

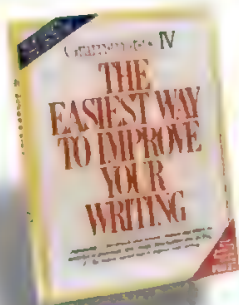
5799	□Ami Professional 1.0	309.
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Softlogic Solutions ... NCP

3548	□Disk Optimizer 4.05	45.
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MMC PC Connection 730M
6 Mill Street
Marlow, NH 03456
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Reference Software ... NCP

□Grammatik IV 1.0—Checks for grammar, style, usage, punctuation and spelling errors in one pass! Now works within WordPerfect 5.1, Microsoft Word 5.0, Professional Write 2.1, WordStar 5.5, XY Write III & more... \$52.



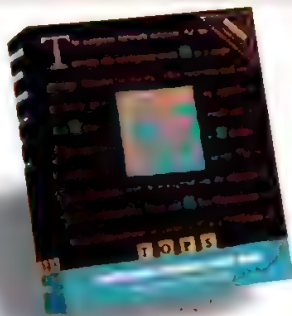
MECA ... NCP

□Home Lawyer 1.0—Let Hyatt Legal Services help you through the legalese by using plain English. Contains 16 commonly used documents and guides you step-by-step through each one... \$69.

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□ **Network Bundle for DOS 3.0**—Allows you to quickly and easily share files, electronic mail and printers between your Apple Macintosh, IBM PC and/or Sun Workstation. Now includes Inbox EMail software \$159.

RECREATIONAL/EDUCATIONAL

Broderbund ... CP

- 5701 □Where/Time Carmen Sandiego? .. \$32.
- 6295 □The Playroom 32.
- 5851 □SimCity 33.

Electronic Arts ... NCP

- 6436 □Hunt for Red October 20.
- 4659 □Chessmaster 2100 (CP) 35.
- 5804 □Deluxe Paint II (Enhanced) 89.

Microprose ... CP

- 4454 □F-19 Stealth Fighter 39.
- 5823 □Red Storm Rising 39.

Microsoft ... NCP

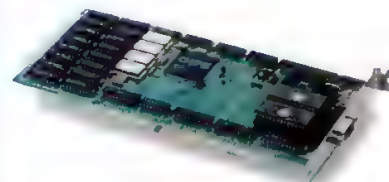
- 2858 □Flight Simulator 4.0 39.

Parlor Software ... CP

- 3159 □Bridge Parlor 2.3 49.

Sierra On-Line ... CP

- 6023 □Leisure Suit Larry III 39.
- 6796 □Codename: Iceman 39.
- 5106 □Space Quest III 39.



Boca Research ... 5 years

1024 VGA—Affordable 16-bit non-interlaced graphics with 512K. Perfect solution for Windows, AutoCAD \$219.
SuperVGA—(800 x 600) 16/8-bit 135.
VGA—(640 x 480) 16/8-bit 119.

- 3720 Flashcard 2.1 (AppleTalk network card; 1 year warranty) 155.
- Traveling Software ... NCP**
- 4190 Battery Watch 2.0 (3 1/2" only) 35.
- 5179 □LapLink III 3.0 95.
- True BASIC ... NCP**
- 3561 □True BASIC 2.1 52.
- Vericomp ... NCP**
- 3765 □SoftBytes 2.0 35.
- 6771 □Memory Master 1.0 45.
- WordPerfect Corp. ... NCP**
- 3799 □WordPerfect Library 2.0 75.
- 3804 □WordPerfect 5.1 265.
- 6685 □DrawPerfect 1.0 279.
- WordStar International ... NCP**
- 2825 □WordStar Prof. 6.0 279.
- 6790 □Upgrade to Version 6.0 89.
- Xerox ... NCP**
- 3812 □Ventura Publisher 2.0 529.
- XTREE ... NCP**
- 6161 □XTreePro Gold 1.3 75.



TIMESLIPS ... NCP

□ **PercentEdge 1.0**—Calculate mortgage rates, present values, annuities, savings and loan balances, and more. Fill in the blank interface completes the calculation once sufficient data is entered. "Pop-up" mode available .. \$69.

Spectrum Holobyte ... NCP

- 5993 □Welltris 22.
- Stone & Assoc. ... NCP**
- 3435 □My Letters, Numbers, Words (2 to 6) 22.
- 3438 □Young Math (ages 5 to 8) 22.
- 3439 □2nd Math (ages 7 to 16) 27.
- True BASIC, Inc. ... NCP**
- Kernery/Kurtz Math Series:
10 titles each 45.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

American Power ... 2 years

- 6812 200DL (stand-by power source) .. 155.
- 6811 360SX (stand-by power source) .. 255.

AST Research ... 2 years

- 1299 SixPakPlus 384k C/S/P 187.

- 6795 SixPak 286 512k 209.
- 4107 RAMpage Plus 286 512k 419.
- 4105 RAMpage Plus Micro Channel 512k 419.
- Boca Research ... 5 years**
- 7001 BOCARAM/AT PLUS (0-8 Meg ext.) 135.
- 7000 TophAT (16-bit backfill 512K to 640K, with OK) 79.
- 6998 I/O Board for AT 59.
- 6999 I/O Board for Microchannel S/S/P . 109.
- Brother International ... 1 year**
- 5787 HL-8e Laser Printer 1799.
- 5788 HL-8Ps PostScript Laser Printer . 2949.
- Computable ... 2 years**
- 1604 2-Position switch box 25.
- Cuesta ... 1 year**
- 1608 DataSaver 400 Watt (power backup) 429.
- Curtis ... lifetime**
- 1694 Emerald SP-2 36.
- 1707 Ruby SPF-2 (6 outlets) 55.
- 1708 Ruby-Plus SPF-2 Plus 65.
- Datadeak ... 3 years**
- 6901 Switchboard 175.
- Diconix ... 1 year**
- 5655 150 Plus Printer (Parallel) 359.
- Epson ... 1 year**
We are an authorized Epson Service Center:
- 1906 FX-850 (80 col., 264 cps, 9 pin) .. call
- 1904 FX-1050 (136 col., 264 cps, 9 pin) .. call
- 5183 LQ-510 (80 col., 180 cps, 24 pin) .. call
- 1930 LQ-850 (80 col., 264 cps, 24 pin) .. call
- 6765 LQ-1010 (136 col., 180 cps, 24 pin) call
- 1917 LQ-1050 (136 col., 264 cps, 24 pin) call
- 4116 LQ-2550 (136 col., 333 cps, 24 pin) call
- 5184 LX-810 (80 col., 180 cps, 9 pin) call
- 1052 Printer-to-IBM cable (6 feet) 15.
- 5th Generation ... 1 year**
- 3952 Logical Connection 512k. 449.
- Hayes ... 2 years**
- 2307 Smartmodem 2400 349.
- 2308 Smartmodem 2400B (w/Smartcom II) 279.
- Hercules ... 2 years**
- 2318 Graphics Card Plus 189.
- Hewlett-Packard ... 1 year**
- 6754 LaserJet III (w/toner) 1679.



Micro Logic ... NCP

□ **Info Select 1.1**—The fastest most exciting new way to deal with notes, ideas, plans, contacts, and all your RANDOM information. Easy yet powerful. Endless uses. \$55.

What your PC needs.



Intel ... 5 years
Above Boards—FREE Quarterdeck QRAM and Manifest with any Above Board or piggyback, now through December 31, 1990! see Intel listing for prices.

- 6582 LaserJet IIP (w/toner) 1039.
- 6581 DeskJet Plus (w/ink cartridge) 719.
- Intel ... 5 years**
- 6421 2400B MNP Internal Modem 199.
- 2352 2400B Internal Modem 2 (for PS/2) 249.
- 5119 2400 Baud External Modem 179.
- 6420 2400EX MNP Modem 229.
- 2346 Inboard 386/PC w/1 Meg (w/free Ami) 519.
- 4266 Above Board Plus 512k 419.
- 4267 Above Board Plus I/O 512k 449.
- 5336 Above Board Plus 8 2 Meg 599.
- 5342 Above Board Plus 8 I/O 2 Meg ... 629.
- 4272 Above Board 2 Plus 512k 469.
- 5396 Above Board MC 32 0k 359.
- 4275 Connection CoProcessor (w/Fax-it). 529.
- 4857 Visual Edge 449.
- MATH COPROCESSORS**
- 2370 80287-8 (for 8 MHz 80286 CPU's) . 199.
- 2369 80287-10 (for PS/2 Models 50 & 60) 229.
- 4750 80387SX (for 80386SX CPU's) . . . 309.
- 2371 80387 (for 16 MHz 80386 CPU's) . . 349.
- 2372 80387-20 (for 20 MHz 80386 CPU's) 399.
- Kensington Microware ... 1 year**
- 2587 Master Piece Plus Remote 89.
- 2582 Master Piece Plus 109.
- 5697 Expert Mouse (Trackball for PS/2) . 115.
- Keytronic ... 3 years**
- 4518 101 Plus Keyboard 99.
- Kraft ... 5 years**
- 5801 New Game Adapter (2 game ports). 27.
- 5800 3 button Thunder Joystick. 29.
- 5802 Trackball 69.
- Logitech ... limited lifetime**
- 5464 Series 2 Mouse (C9 for PS/2's) 69.
- 5151 HiREZ Mouse (C9) 85.
- 6029 Trackman (Trackball) serial 85. bus 89.
- 4297 ScanMan Plus (hand scanner) 185.
- 6786 ScanMan w/Catchword 1.0. 315.
- Micron Technology ... 2 years**
- 6669 Intensify 2 Meg Expansion for HP LaserJet II (upgradeable to 4 Meg). 329.
- 6013 Beyond Mem. Brd. for Model 50 (512k) 359.
- Microsoft ... lifetime**
- 2897 Mouse with Paintbrush 109.

- 2898 Mouse with Windows 286 2.1 ... \$139.
- MicroSpeed ... 1 year**
- 6007 PC-TRAC Trackball serial 75. bus 85.
- 6010 FastTRAP 3D Trackball serial 99. bus 109.
- Mouse Systems ... lifetime**
- 5997 Trackball (1 yr. wrnty.) serial 75. bus 85.
- 4306 PC Mouse II w/PC Paint+ 89.
- NEC ... 2 years**
- 4799 Multisync 2A (VGA Monitor) 499.
- 5085 Multisync 3D Monitor 689.
- 6208 Multisync 4D Monitor. 1199.
- Orchid Technologies ... 4 years**
- 4690 ProDesigner VGA (800 x 600) 249.
- PC Power & Cooling ... 1 year**
- REPLACEMENT POWER SUPPLIES**
- 3202 Turbo Cool 150 (25° - 40° cooler) 129.
- 3200 Silencer 150 (84% noise reduction) 115.
- Pacific Data Products ... 1 year**
- 6779 25 Cartridges in One! (for LJ II, IIP, IID). 275.
- 6840 Memory upgrade for LaserJet 2P/III 1 Meg 179. 2 Meg 249.
- 6833 Pacific Page (PostScript Cartridge for LaserJet IIP) 379.



Intel ... 5 years
Connection CoProcessor—Send/receive faxes at up to 9600 bps from within many popular applications or transfer files with the 2400 bps modem option. Includes free copy of FAX-it software. New low price ... \$529.



Intel ... 5 years
Inboard 386/PC with Free Samna Ami—Gives you 80386 processing power, 1 Mb RAM, and Samna's powerful windows-based word processor (regularly at \$129). 30 Day Money Back Guarantee. New low price. \$519.

- Practical Peripherals ... 5 years**
- 3101 1200 Baud Internal Modem 65.
- 3100 1200 Baud External Modem (mini) . 77.
- 3103 2400 Baud Internal Modem 135.
- 3102 2400 Baud External Modem 179.
- 5286 2400 Baud Int. MNP Modem (Lex. 5) 175.
- 5285 2400 Baud Ext. MNP Modem (Lex. 5) 209.
- 4542 2400 Baud Internal Modem for PS/2. 229.
- Safe Power Systems ... 2 years**
- 4562 Safe 425W (standby power bkup) 329.
- 6747 Safe 400S. 409.
- SOTA Technology ... 2 years**
- 5111 SOTA 286i-12 (12 MHz accelerator) 269.

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MMC **PC Connection** **730M**
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The newest modems from Intel provide MNP/Level 5 support for faster, more reliable communications. Also operates in Hayes-compatible mode for standard communication tasks.
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DRIVES

IOMEGA ... 1 year		
5116	Bernoulli II Single 44 Meg Internal	\$995.
5117	Bernoulli II Dual 44 Meg External	1969.
5113	44 Meg Cartridge Tripak (5 1/4")	249.
2499	PC2 Card (controller required)	169.
Mountain Computer ... 1 year		
2917	40-60 Meg Internal Tape Drive	379.
5502	83-152M Ext. Tape Drive	799.
5500	83-152M Int. Tape Drive	629.
5190	DC2000 Pre-formatted Cartridges ea.	35.
Pacific Rim ... 1 year		
5010	1.2 Meg External (for PS/2's)	215.
6602	1.44 External (for PC/XT/AT)	239.
Plus Development ... 2 years		
3106	Hardcard 40 Meg (28 ms)	599.
6425	Hardcard II 40 Meg (19 ms)	599.
6424	Hardcard II 80 Meg (19 ms)	699.
Seagate ... 1 year		
FREE PCTV® Hard Drive Installation		
Tape with purchase of 20, 30 or 40 Meg		
Seagate drive for the IBM PC (not for		
AT). Beta or VHS.		
2285	20 Meg Internal Hard Drive ST225	
	(w/controller and cables, 65 ms)	275.



Datadesk ... 3 years

Switchboard—The first modular, user configurable keyboard. Numeric keyboard, cursor keys can all be moved around to suit lefties or righties. Same story with optional trackball, function key, and macro key modules \$175.

2286	30 Meg Internal Hard Drive ST238	
	(w/controller and cables, 65 ms)	289.
4554	40 Meg Int. HD ST251-1 (28 ms)	359.
2287	40 Meg Int. HD for PC ST251-1	
	(w/controller and cables, 28 ms)	419.
TEAC ... 1 year		
4951	720k Drive (specify XT or AT, 3 1/2")	79.
4670	1.44 Meg Drive for XT (3 1/2")	99.
4326	1.44 Meg Drive for AT (includes Basteck software utilities, 3 1/2" copy prot.)	119.

MISCELLANEOUS

Checkfree		
6360	CheckFree	25.
CompuServe		
1676	CompuServe Information Service	24.

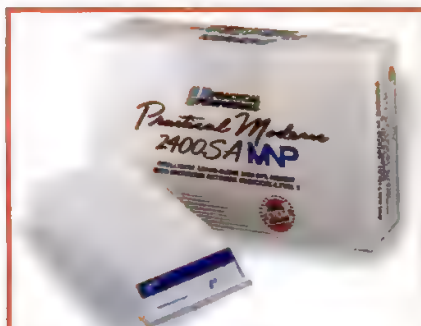
Cables ... lifetime

1019	Smartmodem-to-AT cable (10 feet)	\$15.
5511	Right Angle Printer cable (6 feet)	15.
1050	Parallel Printer cable (15 feet)	19.

DISKS

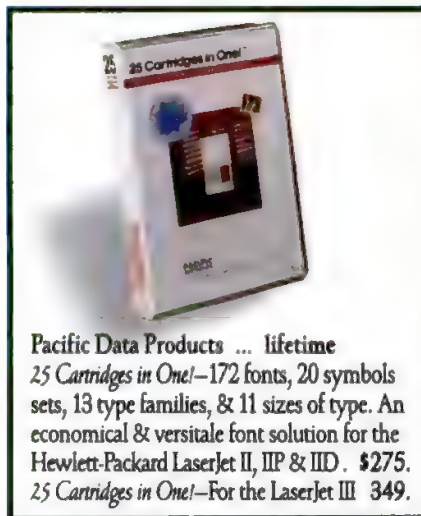
Maxell ... lifetime

2789	5 1/4" MD2-D 360k Disks (Qty. 10)	13.
2790	5 1/4" MD2-HD 1.2Mb Disks (Qty. 10)	19.
2792	3 1/2" DS/DD 720k Diskettes (Qty. 10)	15.
2793	3 1/2" DS/HD 1.44Mb Diskettes (Qty. 10)	29.



Practical Peripherals ... 5 years

2400SA MNP—Fully supports error-free MNP Level 5 data transmission, giving you more confidence in your communications. Also supports Hayes compatible 2400 bps standard operation. \$209.



Pacific Data Products ... lifetime

25 Cartridges in One!—172 fonts, 20 symbols sets, 13 type families, & 11 sizes of type. An economical & versatile font solution for the Hewlett-Packard LaserJet II, IIP & IID. \$275.

25 Cartridges in One!—For the LaserJet III 349.

Sony ... lifetime

3291	5 1/4" DS/DD 360k Disks (Qty. 10)	12.
3292	5 1/4" DS/HD 1.2Mb Disks (Qty. 10)	19.
3297	3 1/2" DS/DD 720k Diskettes (Qty. 10)	14.
3298	3 1/2" DS/HD 1.44Mb Diskettes (Qty. 10)	29.
6659	QD 2000 Tape Cartridge	19.
6712	QD 600A Tape Cartridge	27.
6715	QD 6150 Tape Cartridge	27.

MEMORY

6556	256k DRAMs (100 nanosecond)	call
3248	256k DRAMs (120 nanosecond)	call
4366	1 Meg x 9 SIMMs (100 nanosecond)	call
5510	1 Meg x 9 SIMMs (80 nanosecond)	call
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SOFTWARE FLAT-FILE DATABASES

also lacks functions for statistical operations and averaging, and the manual, while nicely typeset, is among the most poorly organized I've seen.

In terms of speed, the program is a good performer, but I wouldn't wholeheartedly recommend it until the company introduces a new version with an improved interface.

RapidFile

RapidFile is the epitome of the lean, mean, and easy-to-use flat-file database. Designed for simple, elegant, and fast file management, the \$295 product from Ashton-Tate keeps data displayed in the work surface while you use pull-down menus, similar to those used in the two GUI-based flat-file products. A range of function- and control-keys accelerate access to menu options and make navigation easier.

RapidFile excels in the creation of multiple views of a data file. While not as sophisticated as *Reflex*, it offers a number of facilities for selecting and formatting a

let you select whole subsets of a table via search criteria or by tagging individual records. With a selection activated, only the affected records are displayed and liable to global operations. Record deletion works similarly: deleted records are hidden from view, but not removed, until you save the file—you can recall them at any time up to that point.

You can combine layouts and selections to create a powerful tool for manipulating data and generating reports. In fact, you can collect a layout, a set of selection criteria, print settings, and the sort order in a file "snapshot" that can be saved and recalled for later use.

PERFORMANCE THAT SUITS THE NAME

RapidFile is appropriately named; in our benchmark tests it scored better with greater consistency than any other product in the group. Its performance during the import and sort tests for 50 and 500 records was the fastest across the board. However, *RapidFile* spent a significant amount of time saving the file on the 5,000-record tests. The global change results were fastest on all counts.

One reason for its speed is that *RapidFile* rarely writes file modifications to disk, although it does prompt you to save the file before exiting or performing a major operation. So you get the speed advantage but run the risk of losing changes if a power outage occurs. Nevertheless, its minimal disk activity makes



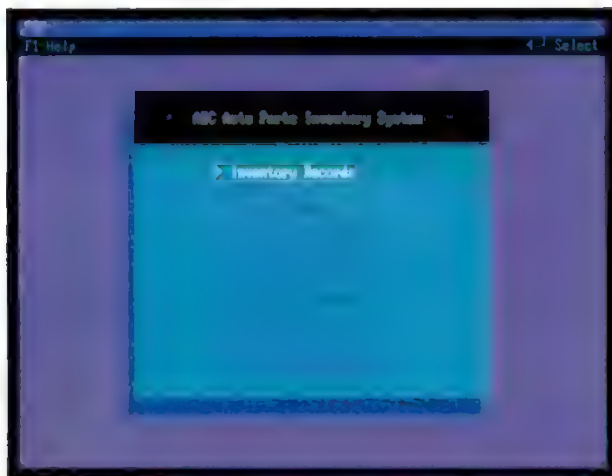
FACT FILE

Professional File, Version 2.01
Software Publishing Corp.,
1901 Landings Dr., P.O.
Box 7210, Mountain View,
CA 94039; (415) 962-
8910.
List Price: \$299; optional
LAN pack, \$499.
Requires: 512K RAM,
DOS 2.0 or later.
In Short: A fast but not particularly powerful
flat-file DBMS with a forms-based approach to
data management. While its custom
application feature is interesting, you'll find
better alternatives among other flat-file
databases.

CIRCLE 397 ON READER SERVICE CARD

Software Publishing supplies a \$499 LAN pack that allows access for up to five users on Novell, 3Com, or IBM's Token-Ring networks. This same LAN pack supports Software Publishing's *Professional Write* and *Professional Plan* as well.

Professional File's performance is respectable, although it's a little slow when importing, particularly when dealing with



Professional File's Autopilot, a simple applications generator, lets you create custom menus and use prepared views and reports.

larger files. The program scored in the upper half on the sorting, reporting, and global change benchmark tests, and it boasts the fastest file search times on all but the 5,000-record file, where it came in third.

Frankly, I found *Professional File* to be rather antiquated. The forms-based approach is not intuitive, and sometimes it's downright confusing: I can't recall another program in recent history that prefers date fields to default to the "YYYY/MM/DD" format. The program

subset of rows and columns. For instance, you can create up to 250 file layouts to control the *fields*, displays, and formatting. A single keystroke can display date fields in a variety of ways (including American and European formats), and there are five different label layouts (plus two each for envelopes and Rolodex). While you typically display only one layout at a time, you can split the screen between table and record-based file layouts.

Record selection facilities in *RapidFile*



FACT FILE

RapidFile, Version 1.2
Ashton-Tate Corp., 20101
Hamilton Ave., Torrance,
CA 90509; (800) 227-4866,
(213) 329-8000.
List Price: \$295.
Requires: 256K RAM, DOS
2.0 or later.
In Short: A fast and lean
flat-file manager that's easy
to use and excels at providing multiple,
configurable subsets of a data file—making
reports and labels a snap.

CIRCLE 398 ON READER SERVICE CARD

RapidFile the perfect flat-file program for PCs and laptops without hard disks.

Among the program's interesting features is a word processor with an 80,000-word spell-checker and a thesaurus with 470,000 synonyms and 40,000 entry points. The word processor lets you pre-

SOFTWARE FLAT-FILE DATABASES

pare mail-merge letters and format and edit memos. You can attach memos to database files by storing the filename in one of the fields. Keyboard macros and a macro editor are also available, and while the report layout lacks financial functions, it does offer a healthy set of string and data facilities.

However, a few things keep *RapidFile* from being a great flat-file database. While the program can import and export *dBASE* files, it cannot read or update them, which is odd for a product that comes from

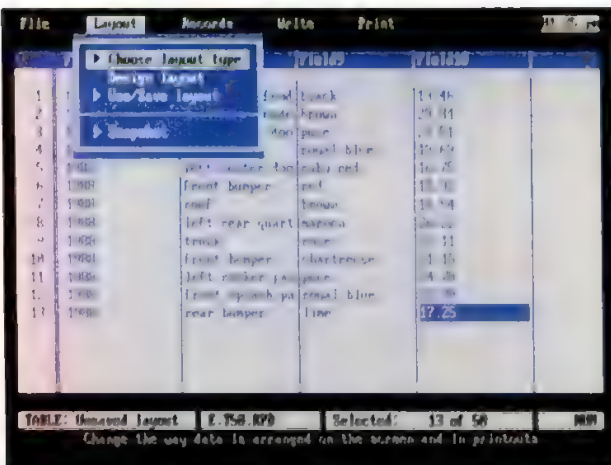
ous) views of a file. Its graphical interface will appeal to almost everyone except the experienced *Microsoft Windows* user: actions that are idiomatic with one are impossible with the other. For instance, with *Reflex* you can't double-click on list-box items, and most windows are not movable or scrollable.

Reflex offers some interesting subtleties. Its Find-Filter not only lets you find records that meet a specific criteria, but

ries, and select from line, bar, stacked bar, scatter or pie charts, as well as from a full selection of colors and patterns. While the graphs are displayed, *Reflex* will dynamically update them when changes are made to values in the database.

Reflex enhances its spreadsheetlike approach by including a full set of *Lotus 1-2-3*-style @ functions that have financial, logical, string, text and date extensions. These can be used in reports, queries, graphs, and crosstabs. You can apply them to form letters or make them the basis of calculated fields to automate and validate data entry. (Calculated fields rely on data stored elsewhere in the table; *Reflex* automatically updates these when the data changes.)

Sporting the usual file import/export capabilities, *Reflex* will also translate *Quattro Pro* and *Symphony* files. You can customize your own translation specifications and save them for later use. Surprisingly, there's no built-in translation specification for importing delimited ASCII files. Although the manuals provide an example for creating one, there's little excuse for its not being included at the outset.



Ashton-Tate's flat-file database package, *RapidFile*, gives you the tools you need to create "custom layouts" of the fields and records you want to see from a file.

Ashton-Tate. With other programs, you create a file structure first, before you import the file, by setting up field names and other characteristics. Since *RapidFile* will not import from an ASCII file into an existing file structure, you face the tedious work of defining field names and changing characters to numeric fields after importing. Moreover, the program also will not simply accept paths in filenames—you must use *RapidFile*'s own facilities for changing drives and/or directories first. Lastly, only by inserting and removing formulas from field definitions can you make global file modifications.

These annoyances can make *RapidFile* a pain to use, but you have to balance them against the product's overall simplicity, ability to manipulate views, and raw speed. On these counts, there's nothing better than *RapidFile*.



At first glance, Borland International's \$249.95 *Reflex* resembles its spreadsheet cousin, *Quattro Pro*. Its integrated, mouse-driven GUI offers instant graphing of your data, sophisticated querying and report facilities, and multiple (even simultane-

you can create filters to include or exclude records that meet the conditions you specify. This has the effect of creating a relational database-style view. While other flat-file databases offer some facilities like this, *Reflex* is the only one to make views convenient, and easy to store and recall.

Other than *PC-File*, *Reflex* is the only flat-file DBMS with the ability to graph your database. Unlike *PC-File*, *Reflex* lets the graph view share the display with other views. You can build graphs of the data in individual records or from summa-

NO-SWEAT OPERATIONS

Reflex, one of two flat-file packages that support crosstabs, makes using them a cinch: open the Crosstab view, select a summary field, rows, columns, and a summary function (@SUM, @AVG, etc.), and *Reflex* will do the rest. You can also set up the column and row headings.

Reports and labels present no difficulty, either. In Report view, a template lets you set up an introduction and a conclusion, as well as the requisite header, footer and body. Field positioning, formatting and summarization are only a



Reflex uses a graphical user interface to display up to four different views of a database: clockwise from the upper-left corner are record view, crosstabs, graphics, and list view.



BENCHMARK TESTS: FLAT-FILE DATABASES

Testing on databases that contain 500 and 5,000 records reveals patterns of performance degradation under increased load. Although *Reflex* shines on certain individual tests, on the test that counts most—searching 500 and 5,000 records—*Professional File*, *Q&A*, and *RapidFile* are the flat-file database speed champions.

The **Import** test measures how quickly the database can import an ASCII file (of either fixed-field length or comma-delimited format) with an index on the first field. We included the indexing portion of the test to avoid penalizing programs that automatically index the first field during data conversion. Some programs required a two-step process for this test: an import followed by indexing.

The **Sort** test measures the time it takes for the package to sort the files on an unindexed field in ascending order.

The **Extract** test measures the time it takes the program to extract two fields from the database and send them to a RAM disk or to the screen. As part of this procedure, the DBMS was also required to sort on one of the fields and select fields that matched one specific criterion. We output the file to a RAM disk or to the screen to eliminate printer performance as a factor in the timed results.

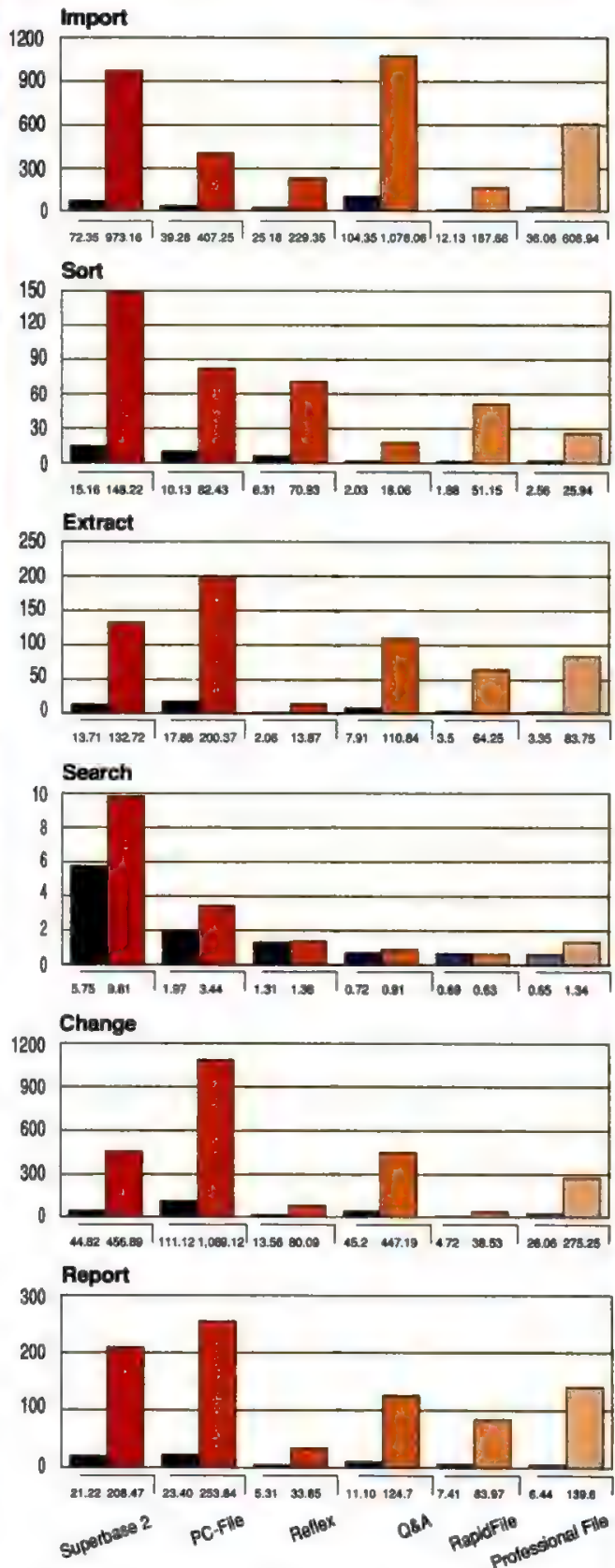
The **Search** test measures the time it takes to locate the first record that satisfies two criteria (make = Fendhi and model = coupe).

The **Change** test reflects the time necessary to run a global search and replace on a specified text field.

The **Report** test records the time it takes to generate a relatively complex report, requiring the reviewer to complete the following tasks: (1) Extract records with fields that match either one amount or another (for example, the "year" field had to equal 1988 or 1989). (2) Select seven of the 12 fields in the record. (3) Sort on two fields, one in ascending, the other in descending order. (4) At the breakpoints in a specified field, calculate subtotals, then calculate the grand total at the end of the column. (5) Send the resulting file to a RAM disk.

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Mary Flynn, PC-Magazine, The Best of 1989



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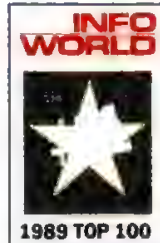
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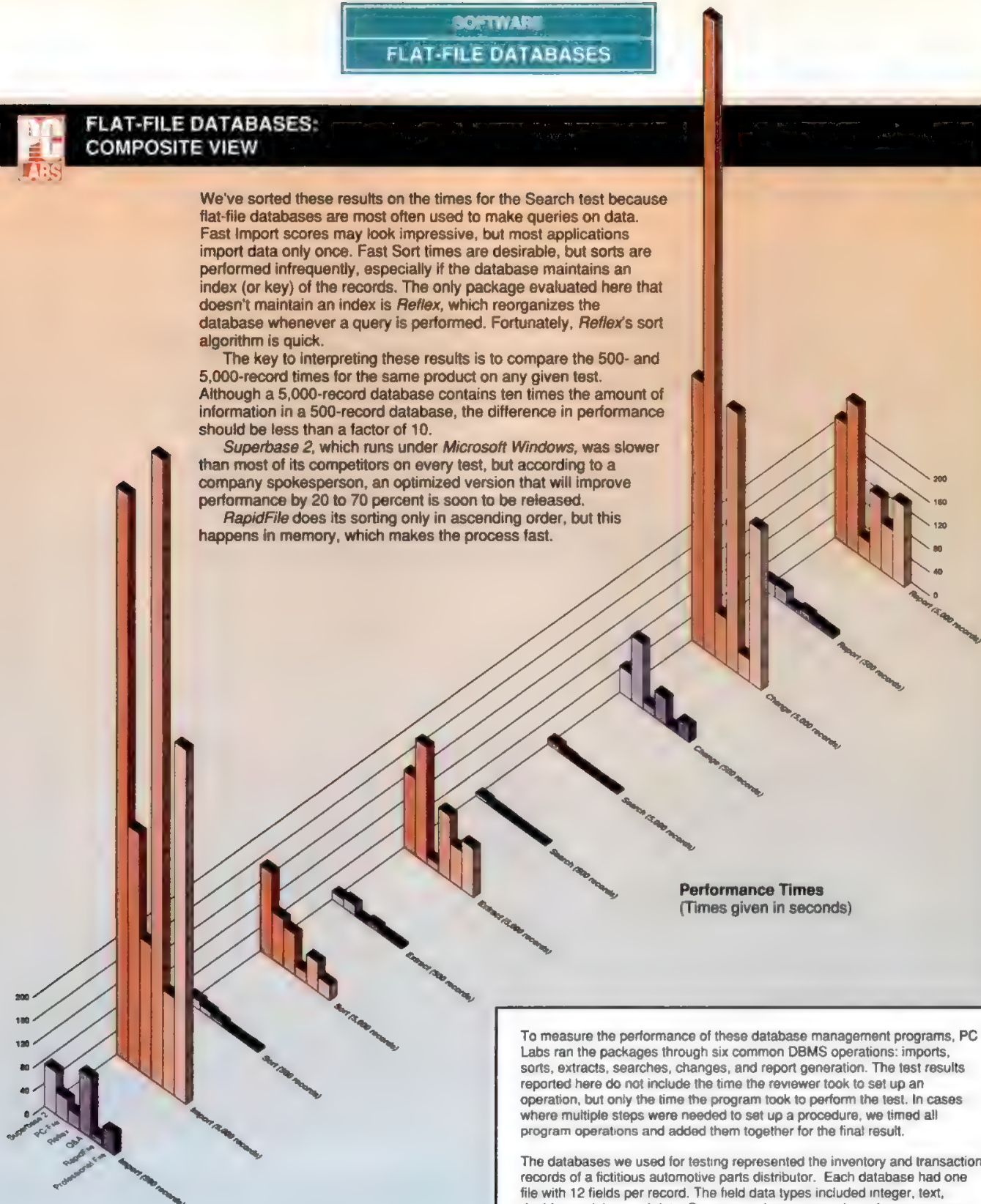
FLAT-FILE DATABASES: COMPOSITE VIEW

We've sorted these results on the times for the Search test because flat-file databases are most often used to make queries on data. Fast Import scores may look impressive, but most applications import data only once. Fast Sort times are desirable, but sorts are performed infrequently, especially if the database maintains an index (or key) of the records. The only package evaluated here that doesn't maintain an index is *Reflex*, which reorganizes the database whenever a query is performed. Fortunately, *Reflex*'s sort algorithm is quick.

The key to interpreting these results is to compare the 500- and 5,000-record times for the same product on any given test. Although a 5,000-record database contains ten times the amount of information in a 500-record database, the difference in performance should be less than a factor of 10.

Superbase 2, which runs under *Microsoft Windows*, was slower than most of its competitors on every test, but according to a company spokesperson, an optimized version that will improve performance by 20 to 70 percent is soon to be released.

RapidFile does its sorting only in ascending order, but this happens in memory, which makes the process fast.



To measure the performance of these database management programs, PC Labs ran the packages through six common DBMS operations: imports, sorts, extracts, searches, changes, and report generation. The test results reported here do not include the time the reviewer took to set up an operation, but only the time the program took to perform the test. In cases where multiple steps were needed to set up a procedure, we timed all program operations and added them together for the final result.

The databases we used for testing represented the inventory and transaction records of a fictitious automotive parts distributor. Each database had one file with 12 fields per record. The field data types included integer, text, double-precision, and date. Because a given program's performance may vary with the size of the database, we report the results using separate databases of 500, and 5,000 records.

We tested each database on a 16-MHz IBM PS/2 Model 80 with 4MB of RAM configured according to the vendor's recommendation for optimum performance of the particular package.

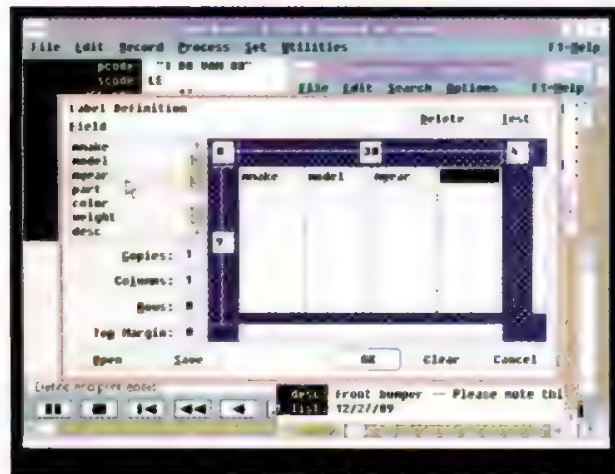
ENDS

point-and-click away. *Reflex* lets each report have its own sort controls and file filters, independent of those on the current database, and report definitions can be saved and reused with any file that has the appropriate field names. Labels are just as easy: choose from one of several predefined types, and optionally adjust the dimensions to fit.

Reflex's performance across the board ranges from respectable to excellent. While its file import speed placed it in the bottom half of the group, its sort, search, and change times were square in the middle or better, especially on larger files. Even better were the extract and report times, which were fastest in all but one instance.

A few deficiencies exist in this generally fine product. For instance, there is no macro facility for automating redundant tasks. Borland suggests purchasing its *Superkey* product for this, but it really should be built in. Second, you cannot look up values in external files, which means you can't use them for data validation or for multifile queries and reports.

Borland's *Paradox Engine* has made *Paradox*-table compatibility and network support (with auto-refresh) a standard in *Quattro Pro* and *SideKick Plus*. However, *Reflex* can only import and export *Paradox* files, and you cannot simultaneously



share *Reflex* files across a network. That's too bad because *Reflex* would be an ideal front end for *Paradox*, and its users would gain access to even larger installed databases.

All things considered, *Reflex* is the most exciting product of the flat-file databases we review here. Its GUI interface, graphing abilities, crosstab support, and handy report and label facilities make it a stunning system.

SOFTWARE FLAT-FILE DATABASES

FACT FILE

Reflex, Version 2.0
Borland International,
1800 Green Hills Rd.,
P.O. Box 660001, Scotts
Valley, CA 95066; (408)
438-8400.
List Price: \$249.95.
Requires: 512K RAM,
DOS 2.0 or later.
In Short: While *Reflex*'s
graphical user interface is slightly nonstandard
and the program lacks multifile lookups, it
offers an excellent price/performance ratio and
is packed with features such as crosstabs and
graphics. An excellent choice in any case.

CIRCLE 399 ON READER SERVICE CARD

Superbase 2

Of all the data managers evaluated here, Precision Software's \$295 *Superbase 2* is the only one that runs under *Microsoft Windows* and, along with *Reflex*, is the only one to provide a graphical user interface. While it doesn't offer *Reflex*'s multiple, simultaneous views of a file or its

Superbase 2 is the only flat-file DBMS evaluated here that operates under *Microsoft Windows*. It includes VCR-like buttons for browsing through the database.

built-in graphics, it takes considerable advantage of the *Windows* desktop metaphor by making each aspect of file management easily accessible via graphical controls and a mouse.

Take table navigation, for example. While you can move from record to record and otherwise steer around the table, it's easier to use *Superbase 2*'s "VCR buttons" (so called because of their close resemblance to the front panel of a VCR).

You can skip forward or backward to a record, or use fast forward and rewind for continuous scans. Other buttons let you jump to either end of the database, and interrupt or stop any activity (like a report, query, or search). You can use the buttons to find a particular record or, alternatively, filter out unwanted records to create a temporary view (or subset) of the database. All this is possible by simply clicking your mouse—how can you get any more user friendly than that?

Superbase 2's interface makes it just as easy to create a query or a report. From a dialog box, you can select fields to be displayed, add controls to a report (like totals and subtotals), or filter out unwanted records. While creating a statement like "sales > 50,000 AND sales < 10,000" requires learning a little of the *Superbase* query syntax, the visual interface makes it a snap: the fields and operators are easily selected from list boxes and push buttons. Even the logical connectors (AND, OR, NOT, etc.) are available via point-and-shoot. You run the query on-screen, save it, and send the output to the printer or a disk file.

PRETTY PICTURES AND MORE

A built-in text editor is available, and you can link text and graphics files to records in a database by adding an "external" field that contains the filename of your document (.PCX or TIFF) to be displayed. When you select a record with related text and graphics images, the external files are displayed in the text editor or the graphics window for you.

By far, this is the best solution I've seen for handling memo fields, and you get the added advantage of keeping pic-

FACT FILE

**Superbase 2,
Version 1.0**
Precision Software Inc.,
8404 Sterling St., Suite
A, Irving, TX 75063;
(800) 562-9909, (214) 929-4888.
List price: \$295.
Requires: 640K RAM, *Microsoft Windows*,
DOS 3.0 or later.
In Short: A flat-file data manager with an
outstanding interface but mediocre performance. Compatibility with the programmable
Superbase 4 is a plus, and its easy-to-use
interface has the ability to display attached
text and graphics files. Will be an excellent
value if performance improves under *Windows*
3.0.

CIRCLE 400 ON READER SERVICE CARD

tures tied to database records, too.

While *Superbase 2* will read and display *dBASE* files, you'll have to import them before you can update them. It does, however, offer file lookups so you can perform validations and create simple relations between multiple *Superbase* files. *Superbase 2* is file compatible with *Superbase 4*, its programmable relational sibling, so you can share data with others regardless of the version they're using. Indeed, *Superbase 2* is actually a subset of *Superbase 4*; while they share the same interface, *Superbase 4* includes a data-

Superbase 2 supports DDE, the mortar for building super applications under Microsoft Windows. It sets the pace for database design.

management application language and the ability to write and run applications.

You get a full complement of extras, like virtual fields and macros to store both keystrokes and mouse events. It offers instant mailing labels (although it's not particularly flexible for handling different-size labels), and pop-up, on-line help. One unusual feature is a built-in communications facility for uploading and downloading data. More important, this is the only database manager in the group that supports DDE, the mortar for building super applications under *Microsoft Windows*.

Superbase 2 suffers in the performance arena: compared with its competition, it's just too slow. It was the second slowest when producing reports, extracting records and importing an ASCII file, and the slowest when performing a search. (It's impossible to comment on its sort time since *Superbase* doesn't sort a table; instead, an index must be used.) Some of its poor performance may be attributable to *Windows*, so perhaps *Superbase 2* will run faster when the improved *Windows 3.0* is readily available.

SOFTWARE FLAT-FILE DATABASES

Slow speed shouldn't prevent you from considering *Superbase 2*, however. The package is almost worth buying for its interface alone, and *Superbase 2* is certainly setting the pace for database design in the nineties.

Q&A

Symantec's *Q&A* is a full-featured flat-file database manager that includes a word processor and an English-language query and reporting interface. While the \$349 package is forms-based like *Professional File*, it's more sophisticated and more powerful.

Q&A offers the widest variety of field formatting and display options among flat-file databases. You can set justification on text and numeric fields and restrict field input to a unique value or a specific range (controlled by internal or external look up tables). You can implement IF-THEN controls on field-formatting formulas and utilize a rich set of functions (which are available in other parts of the program, including reports). These include date, time, financial, mathematical, text and string functions, as well as controls that operate only when editing or adding records.

Q&A also offers a special "keyword"



field type. You can use this feature to store keywords in each record and later search for records associated with one or more keywords. Other search facilities let you retrieve records by exact match or from a range and can even execute phonetic searches.

Unique among the other flat-file pack-

FACT FILE
EDITOR'S CHOICE

Q&A, Version 3.0
Symantec Corp.,
10201 Torre Ave.,
Cupertino, CA
95014; (408) 252-5700.
List Price: \$349.
Requires: 512K
RAM, DOS 2.0 or
later.

In Short: A powerful forms-based flat-file manager with integrated word processing, natural language query interface, keyboard macros, and superb network support. While it falls somewhat short in performance, it's the best buy of the forms-based databases.

CIRCLE 401 ON READER SERVICE CARD

ages evaluated here is *Q&A*'s Intelligent Assistant, a natural language database interface that lets you use English phrases and sentences to query a database, modify forms, find and view records, print reports, and make simple adhoc inquiries. For instance, you can type in a request like "Show me a report of last year's sales for the Northwest division, sorted by salesperson and transaction date." Once the Intelligent Assistant understands your database, it can produce such a report.

"Understands" is the operative word; the Assistant has a built-in vocabulary that's limited to a specific number of

Q&A's natural language interface, the Intelligent Assistant, is capable of "learning" how to display database information extracted from simple English sentences.

commands as well as the names and contents of the fields in your database. For instance, the Assistant would not know "last year's" or "Northwest," while it could figure out "show," "report," "sales," and "division." Fortunately, *Q&A* provides users with a simple means of teaching the Assistant about a particu-



Now that everyone agrees how a computer should work,

Judging by what you see on magazine covers these days, the world now wants what the Macintosh® computer has always had. And, suddenly, the idea that a personal computer should work the way people do has been embraced by virtually every major player.

Well, since "Mac-like" is the promise on every lip, this might be a good time to point out just what a Mac® is like.

What makes a Macintosh a Macintosh is not just cheerful icons, a mouse, pull-down menus and other surface manifestations. A Macintosh is a Macintosh from the inside out. Conceived from the chip up to work intuitively and visually.

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other peripherals all connect together quickly and logically. Just plug them in and turn them on.

Because we engineer both the hardware and its operating software, Macintosh runs with the smooth speed and precision you'd expect from any perfectly integrated design.

And because Macintosh isn't a "graphical" shell grafted on top of a character-based system, it doesn't expend lots of expensive computing power trying to do something it wasn't designed for.

Which is why, for less than it usually costs to buy the software and the high-end hardware needed for a Mac look-alike, you can have the true article.

Instead of making do with a handful of graphicized programs, you can choose from the thousands of highly innovative business applications developed specifically for



try the only one that actually works that way.

Macintosh over the last seven years. And instead of patiently following the long path from yesterday's MS-DOS to Windows in the interim and to OS/2 in the someday, you can make one simple step to Macintosh.

The benefits of that step, according to a new independent study* by Diagnostic Research, Inc., are considerable. It seems people prefer a machine that works like people do.

And they get more done with it.

Users rated Macintosh 14% higher for overall satisfaction and 13% higher for performance than for PCs running Windows. Which, according to information managers in the same study, translated into productivity ratings which were 32% higher.

Meanwhile, what would you sacrifice by making the change to Macintosh?

Not your PC files. Every Macintosh equipped with an Apple® SuperDrive™ disk drive moves information between a Macintosh and an MS-DOS or OS/2 PC on standard 3½-inch floppy disks.

And not your PC programs, either. With products like SoftPC a Macintosh can run virtually any DOS application. We invite you to call 800-538-9696, ext. 875, for the names of your nearest authorized Apple resellers.

Then come in and see what inspired the monumental changes you've been reading about.

After all, now that everybody else is trying to sell you a Macintosh, maybe you should buy one.

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lar database. With a little repetition, it can learn what it needs to interpret complex queries.

In a way, the Assistant is like a built-in programmer: it may take you time to tell it what you want, but the rewards will compensate for the time spent. Once you're through, those who are less computer-literate will be able to take even greater advantage of the Assistant's abilities, particularly if *Q&A* is installed on a network.

Q&A offers the finest network support of all the flat-file packages, and the program includes full file- and record-locking facilities. Each record is automatically locked by the first person to display it; if you try to modify a record already being edited elsewhere, *Q&A* will notify you and provide the network ID of the other user. Once the other user has finished, you can make changes to the newly modified record.

WORD PROCESSING

Although Symantec's *Q&A Write* is sold as a standalone word processor, it's also integrated as a part of *Q&A*. *Q&A Write*

SOFTWARE FLAT-FILE DATABASES

includes a spell checker and mail-merging to produce letters and labels from *Q&A* databases. With printer support for a variety of LaserJet fonts and PostScript, it also lets you insert bitmaps, .PIC files, and *Lotus 1-2-3* files into documents.

Q&A is packed with features, and is a good choice if a forms-based package is your preference.

Q&A offers sophisticated keyboard macros, and they automate routine tasks well enough for you to use them as a programming language. With the *Q&A* macros you can reconfigure the keyboard

(including function-key assignments that are used by the *Q&A* program itself), and you can edit the macros with *Q&A Write*. In addition, the macros can accept variable input so they can be used with data entry fields.

It was surprising to find that *Q&A*'s performance was, at best, mediocre. Its file import times were the slowest of the products tested, and its file extract, global change and report times were mostly in fourth or fifth place. *Q&A*'s file searches were a little better, but only the sort times were consistently respectable—primarily since the file sorts used are temporary and not saved.

Q&A hasn't changed a great deal in the last two years, and a new version without the ancient layers of menus and forms would be welcome; the old interface is overdue for an overhaul. But considering the features that are packed into this product, at \$349 it's worth the extra \$50 over *Professional File* if a forms-based package is your preference. ■

Richard Hale Shaw is a contributing editor of *PC Magazine*.

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Now you can get a single shared printer that can do the job of several machines — print up to nine-part forms, letters, labels, envelopes and other documents. The 8900 Series is a solution that not only makes sense, it saves money.

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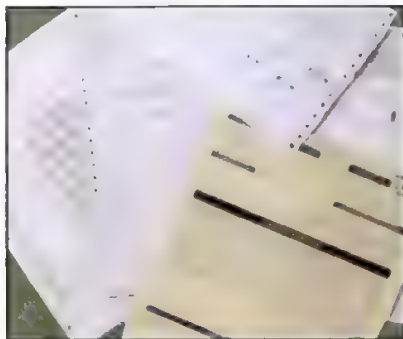
to form width, length and thickness, making form waste and misaligned paper a thing of the past.

You can also say goodbye to complicated controls. Now you can select options like print quality (ranging from

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What's more, with its 16,000 pages-per-month** output capability, an 8900 Series printer is so reliable it can even replace some line printers.

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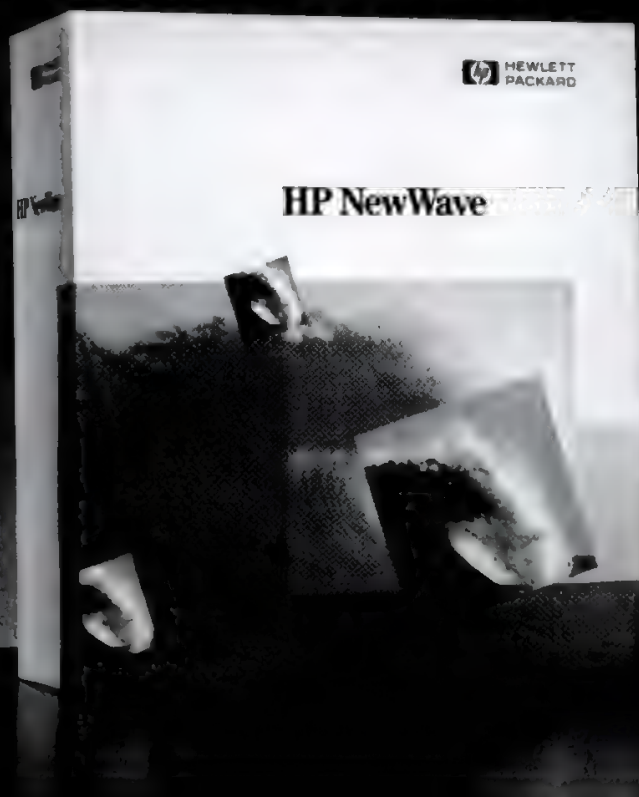
TI's 8900 Series prints a variety of forms
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Quattro Pro

(Borland International)

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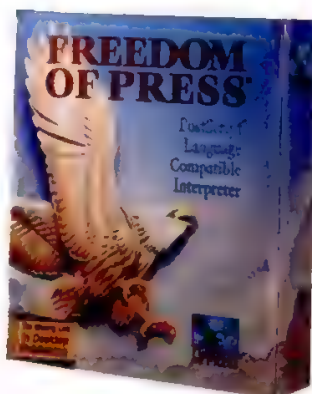
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Panasonic KX-P1124

(Panasonic)

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(hDC Computer Corporation)

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Ultrascript PC Plus 2.0 256.

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Peter Norton

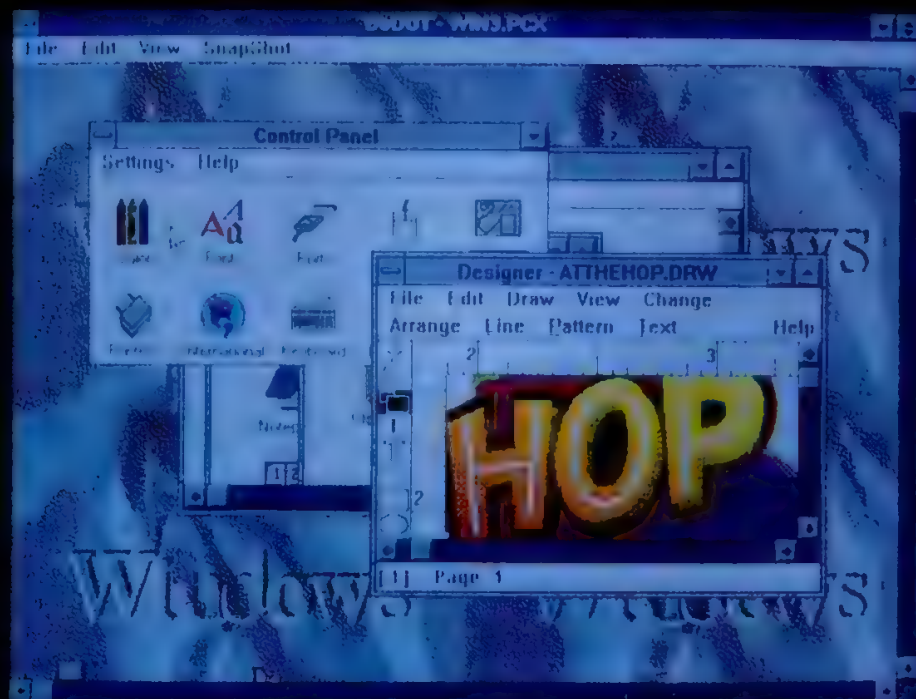
Norton Editor 1.3 47.

Solutions Systems

BRIEF 3.0 for OS/2 179.

The Next Generation of Windows

With Release 3.0, Microsoft Windows lives up to the promise it made in years past. This fully-realized vision of a graphical interface makes applications more productive, thanks to an easy-to-use interface and smooth sharing of data.



FULFILLING THE PROMISE OF A GRAPHICAL ENVIRONMENT

Better Performance, Better Appearance and Lots of Memory Make This Windows a Winner

M

icrosoft Windows 3.0 is personal computing the way it was always meant to be.

Windows 3.0 brings to the PC the ease-of-use, power, color, and naturalness that users of computers have dreamed of since that "\$64,000 Question" Univac in the 1950s, or even the revolutionary IBM PC, introduced just a short nine years ago.

In the Windows 3.0 operating environment Microsoft has punched through the old computer think with a graphical interface and powerful environment that will allow PC users to:

- Work the way they intuitively do.

This means working on the screen on two or more tasks at once, jumping between the applications as the project requires—or when the boss interrupts seeking critical information.

Icons include utilities for managing the systems' display, fonts and installed printers.



- Easily copy data from one project to another—a chart from a spreadsheet into a report for the planning committee, for example.

- Pull data off other computers in their organization—typically an IBM mainframe—in

a format that makes sense to them and can be used readily by PC applications.

- Use a common command structure, so that the same commands work with each program. And there's no more fumbling to find the Help screen: there's always a Help menu at the top of the screen.

- Connect more easily with fellow departmental employees, primarily today, over local area networking technologies.

- Leap beyond the 640K memory barrier in the existing popular MS-DOS or PC-DOS operating system (when running 286, 386, or 486 PCs). While 640K main memory was outrageous in 1981, it's too limited for today's sophisticated applications.

- Create highly customized applications which are unique to their company or departments, but which follow the same conventions as other mainstream applications, such as word processing or project management.

- Link and leverage new applications and computing technologies, such as multimedia applications that combine audio, video, and other technologies.

In Windows 3.0, the third generation of Microsoft's graphical operating environment for the PC, Microsoft finally fulfills the promise and the ideas that have driven the product since its inception. "Windows 3.0 brings us closer to the reality of a computer on every desktop," says Paul Brainerd, the head of Aldus Corp., whose *PageMaker* has been instrumental in demonstrating to users what a graphical user interface (GUI) means to computing, particularly in desktop publishing.

"Windows 3.0 is a very robust environment," agrees Douglas Edwards, executive director of marketing, at Informix Software in Lexana, KS. "Something as simple as cut-and-paste is a phenomenal breakthrough for PC users. People who have only worked in character based PC environments are awed by the rudimentary things that the Macintosh-similar interface does. Windows increases the number of people who can approach the PC and accomplish productive work." Informix' *Wingz* spreadsheet at the same time benefits from Windows 3.0 and competes with Microsoft's *Excel* spreadsheet.

"Windows 3.0 is a very seductive environment," observes Micrografx chief executive Paul Grayson. "Human beings are sensitive to graphics, vision and high resolution images. Visuals provide the broadest bandwidth as to how people communicate, they are sensitive to visual images and a pleasing visual environment. They stimulate the brain as to the various possibilities."

"Elegance," is how Jack Dreiss, a partner at Arthur Anderson & Co. in Chicago, describes the new Windows: "It means a graphical interface where the old was characters with some graphical notion to it." The newly graphical interface has allowed the Big 8 accounting firm

Word's out.

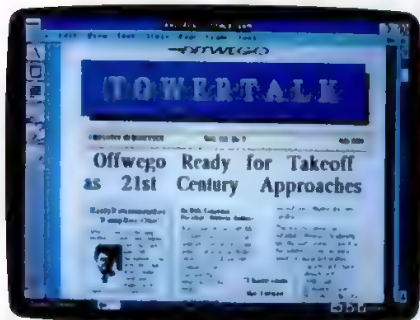
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Whether you're an executive type who



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types only occasionally, or a heavy user who needs lots of specialized features, one of these programs is definitely your type.

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—PC Computing

"The features in Ami Professional are both intuitive and fast... a spectacular achievement by any standard... Word for Windows suddenly faces a formidable challenge."

—PC Magazine

"Ami Professional outperforms the competition and has laid the path for word processing in the 1990's. Its superior layout and graphics-related capabilities in addition to standard features put it a step above the rest."

—InfoWorld

"Samna achieved a remarkable coup surpassing Microsoft and WordPerfect with Ami Professional."

—Software Digest

memos to presentations and newsletters.

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And by making it easy to exploit even the most sophisticated word processing features.

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Software Digest	Overall Evaluation		Program Name
	Rating	Overall Score	
★★★★	7.9	6.9	Ami Professional
★★★★	7.7	7.7	Microsoft Word
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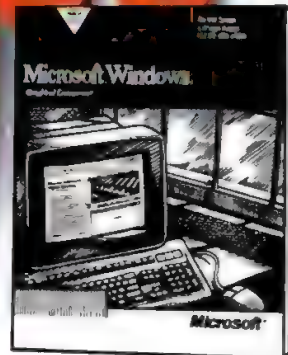
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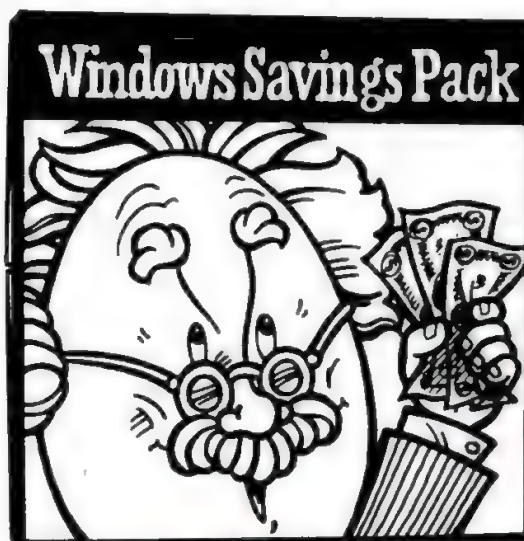
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FULFILLING THE PROMISE OF A GRAPHICAL ENVIRONMENT

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to use *Windows 3.0* to create a full, customized workstation (a Compaq Computer portable) for its tax and audit professionals to take on their client rounds. "*Windows 3.0* was an effective solution to extend DOS," adds Dreiss.

Here *Windows 3.0* Help, cut-and-paste, and customization features allowed Arthur Anderson & Co. to build a system useful for its 15,000 accounting professionals around the world. "The graphical, icon-based system has been espe-

**Microsoft has worked hard
to efficiently manage
memory, so that users with a
80286 and 1MB memory
users can confidently run
two applications**

cially well received in Europe and internationally," Dreiss said. "Europeans are acutely aware of the need for common interfaces," chimes another financial software developer with offices in Europe, John Adinolfi, at IMRS Inc. in Stamford, CT. (In fact, many software marketers—including Microsoft and Aldus—report as much as half of their revenues come from outside the U.S., of late.)

"This elegance, richness, and quality feel to *Windows 3.0* is intentional," tells Russ Werner, general manager of Microsoft's DOS/Windows unit, which was formed about two years ago from the disparate DOS and Windows teams

throughout Microsoft: "Our basic philosophy had two tenets — to make the product more appealing to the increasing number of novice users, and to make a good workstation platform for corporate users." Adds Werner, "the product had to be aesthetically appealing, and sexy — something you want to use."

This new *Windows* SWAT team both recognized the obvious, that the greatest PC growth was at the low-end of the marketplace, and acknowledged *Windows* limitations to date, notably for networking and 3270 connectivity. The new *Windows 3.0* had to work for both professionals and new users. With these goals foremost in mind, the company brought in graphic design artists to rethink and then design the icons and graphical user interface, which go beyond the Macintosh with 3-D design and professional colors.

DOS BECOMES GRAPHICAL IN *WINDOWS 3.0*

Surely, *Windows 3.0* is priced to attract all comers: \$149 retail with \$125 license paks and \$50 upgrades for existing *Windows* users. Likewise, the product has been simplified to one size fits all systems, versus the 80286/80386 distinction in the past.

Certainly, breaking the DOS 640K memory barrier was a major benefit for most developers. *Windows 3.0* can readily access the protected mode of Intel 80286 and 80386 processors, thus opening up all the memory installed on a PC, up to 16MB. Disk access is both optimized and reduced.

To run *Windows* at full throttle, on 80386 systems (only), a portion of the hard disk can be allocated as virtual memory, allowing *Windows* application code and data to be paged to disk—and having the effect of opening up even greater memory to the *Windows* applications running.

Microsoft has worked hard to efficiently manage memory, so that users with a 80286 and 1MB memory users can confidently run two applications; likewise the 80386 will perform at its peak with 2MB memory.

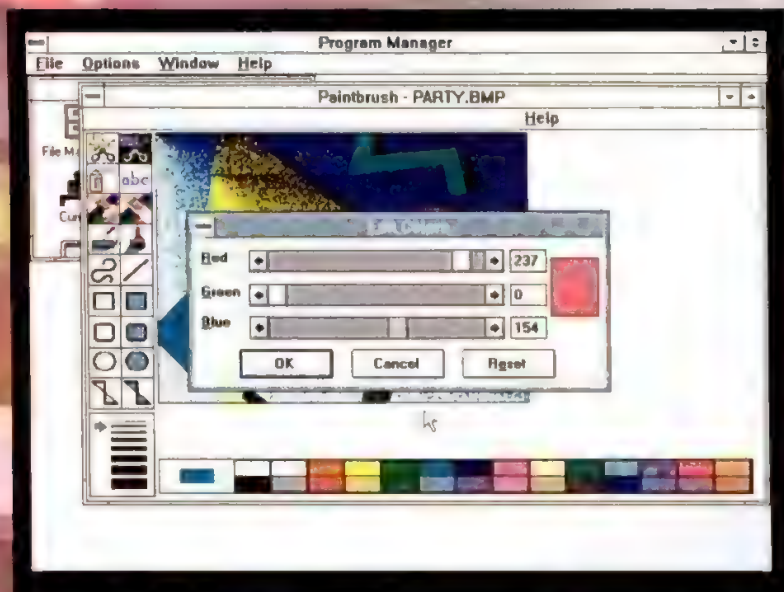
While *Windows* has always boasted its conformity to a graphical user interface. Now, for the first time, the interface is truly graphical — icons direct the action. What's more, it's logical that a graphics-oriented interface is the neatest, most effective key to opening the increasing number of graphics-oriented products in the marketplace. With the release of, *Windows 3.0*, it has matured into an environment which benefits and befits the average user.

ENABLING MULTIMEDIA

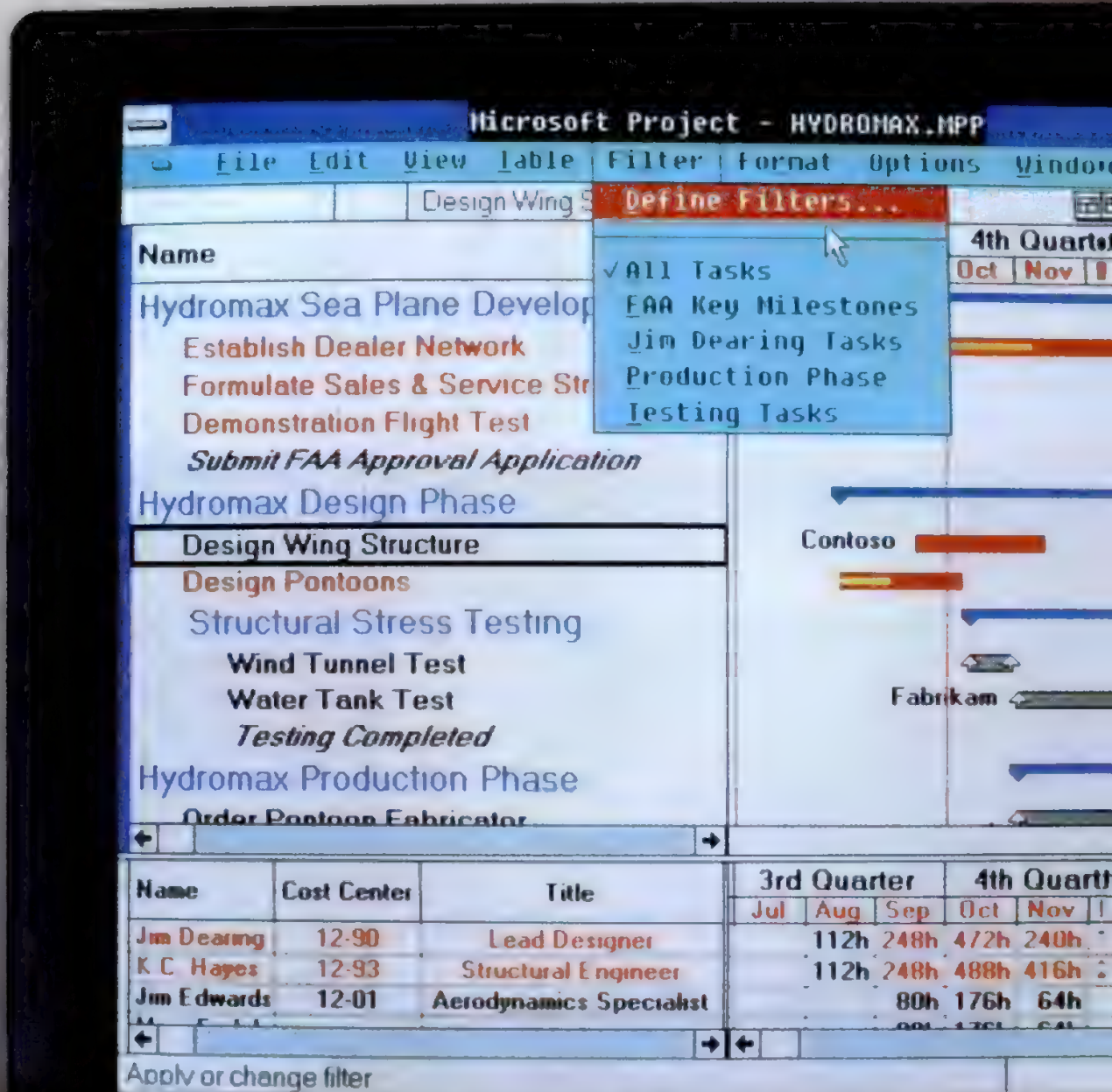
An added hook in *Windows 3.0* promises to make the system more appealing to home users and PC newcomers: sound and natural images or full-motion video can be incorporated in applications, a technique called multimedia.

"Multimedia really will be the technology

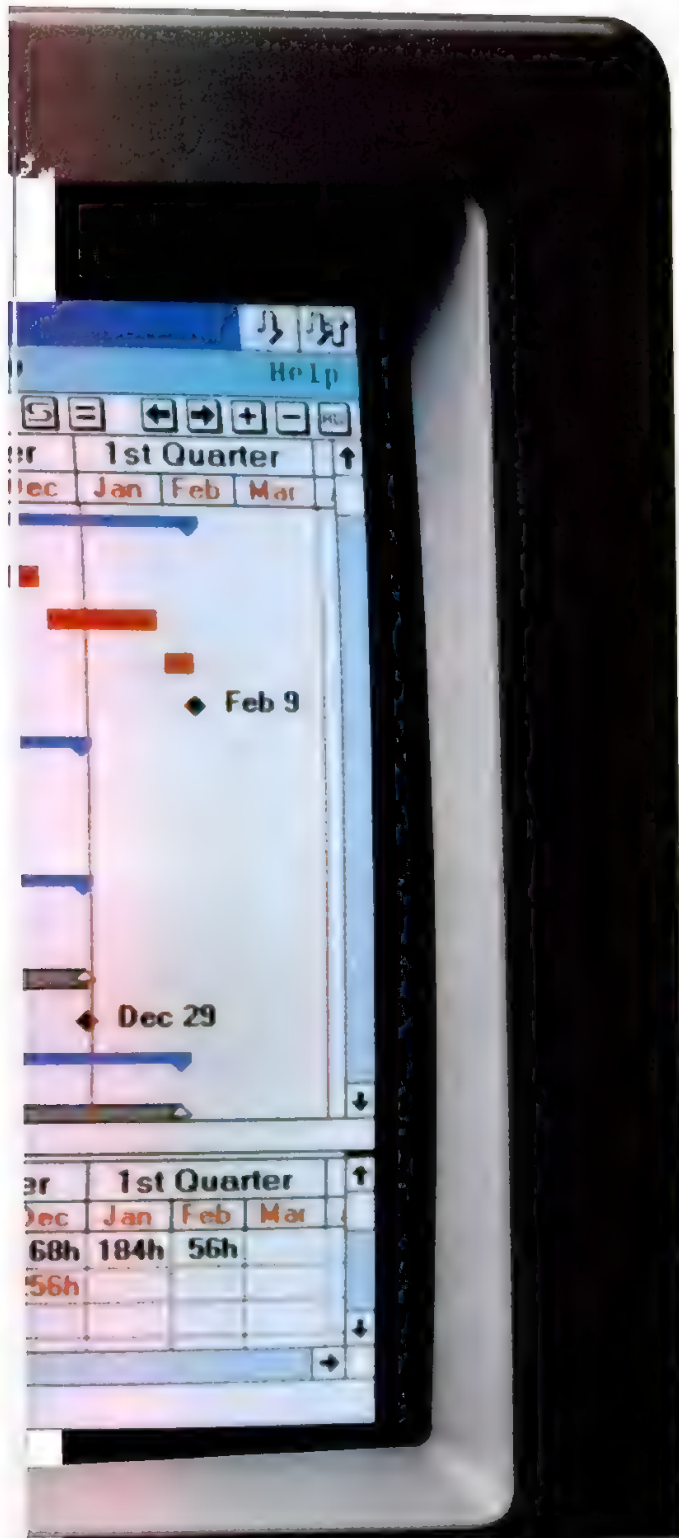
The extra attention to aesthetics in *Windows 3.0* includes an option to let you customize the display screens.



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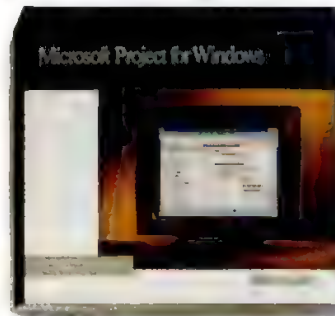
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FULFILLING THE PROMISE OF A GRAPHICAL ENVIRONMENT

continued

that pulls in new users with high quality audio and TV," describes Werner. Thus *Windows* comes multimedia-enabled and Microsoft is currently adding sockets to most efficiently handle the added technologies. Of course, the ultimate challenge is to bring these PC-centered technologies together at an affordable price.

As amazing as it now seems, the first version of *Windows* was announced in November, 1983, and actually released two years later with

**The task list is not
restricted to *Windows*
applications, rather it is
probably the easiest method-
within *Windows* for skipping
back and forth between *Win-
dows* and DOS programs**

much initial puzzlement and incredulity as to what the product was. In those *VisiCalc* and *WordStar* heydays, *Windows* was limited, to say the least, but then so were the computing power of most user's PCs.

The November, 1983 press releases described *Microsoft Windows* as "an enhancement to their MS-DOS operating system that reduces the complexity of the human interface of personal computers." And, *Windows* which was then available only through hardware OEMs, took advantage of "two recent hardware devel-

opments," the mouse and bit-mapped graphics. (Comical in hindsight is the systems prescription: "The hardware requirements for *Microsoft Windows* are 192K of RAM, a bit-mapped display, a mouse and two floppy disk drives. The system does not require the use of a hard disk drive.") The much improved, although still highly menu-oriented *Windows 2.0* was introduced April, 1987.

HARMONIC CONVERGENCE

Looking back now on how *Windows* matured and is capturing many PC user's hearts, Microsoft's Werner sees the importance of timing: During those two development years, graphics became the accepted interface, and the average desktop configuration changed so that one or two megabyte systems are surprisingly common.

Certainly, the arrival of *Windows 3.0* is a sign of the times: After years of hypergrowth in the early 1980s it seemed inevitable that the DOS market would slow in the 1990s as users hit the memory limits. Now, along comes *Windows 3.0*.

"It's gotten pretty confusing out there," reports John Adinolfi, who's company markets a popular PC-based financial consolidation program to multinational organizations. Adinolfi is describing the muddle many users find themselves in because of the tremendous proliferation of personal computing options.

Today's users are eager for the next computing breakthrough.

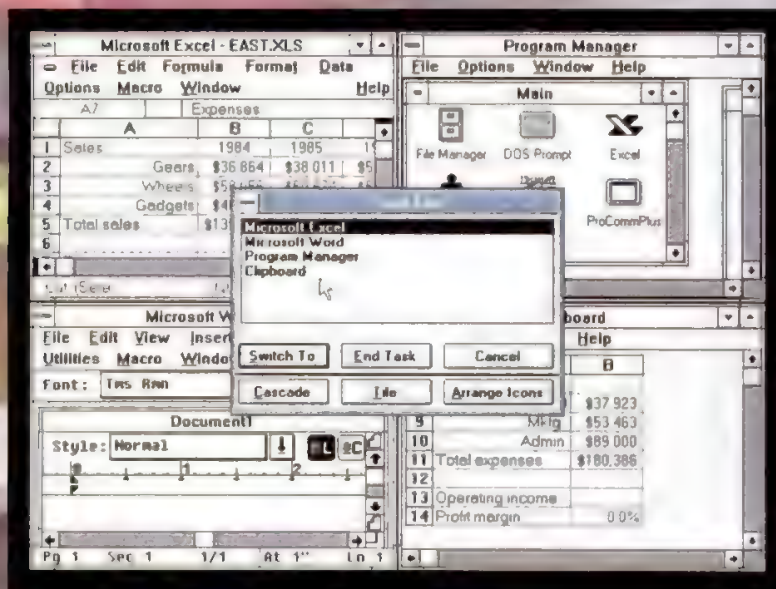
"*Windows 3.0* is a key shot in the arm," agrees William Coggshall, a former Dataquest director who now publishes "*The Desktop Presentations Report*." "It gives people all kinds of excuses to reevaluate what they're doing with personal computing."

It may take 6 to 12 months for companies to accept *Windows 3.0* as standard, versus the 30 to 60 days some developers are predicting, but says Lane Freestone at Zenographics, in Irvin, CA, "*Windows 3.0* is going to give people what they want." Freestone, along with many other developers, sees *Windows* as an ideal interim solution as companies decide what to do about the IBM Operating System/2 (OS/2.)

At Microsoft Corp. itself, the expected switch to *Windows 3.0* in the next 12 to 18 months is estimated at 30 percent of the DOS installed base by Rich Abel, group product manager for *Windows*, although others are more optimistic. But, with an installed base of 2.5 million users, that's a prodigious group of *Windows 3.0* devotees. Of course, Microsoft anticipates new systems will come out of the box running *Windows*—and several hardware providers are ensuring that.

Windows 3.0 may be a stopgap solution for many PC users, "but it's a strongly attractive patch," tells Mark Leavitt, a PC analyst at International Data Corp. (IDC) in Framingham, MA,

The Clipboard and Program Manager helps you keep track of the available programs as you move data around.





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continued

shipments of operating environments (beyond DOS) for the PC, and IDC analysts expect that trend to continue into 1991.

"We believe that the features present in *Windows 3.0* will encourage users to upgrade their current systems and to purchase new systems with a higher level of RAM memory for storage and graphics," said Leavitt. In fact, how users respond to the memory requirements of the enhanced environment will be the litmus test for success. While *Windows 3.0* runs in two megabytes of memory, Leavitt suspects users will require three to five to get the most from their applications.

SOFTWARE REDEFINED

The really big news is that *Windows 3.0* further opens a Pandora's box of applications for the 1990s, most notably graphics presentations, multimedia, and those which generally require greater memory and more technical tricks.

Toolbook from Asymetrix Corp. and Spinnaker Software's *Spinnaker PLUS* are just two of the difficult-to-describe programs that leave users with a thrill of possibility for the new applications they could be developing—themselves. Asymetrix in Bellevue, WA, a start-up company that was formed precisely to take advantage of new environments like *Windows 3.0*, is bundling a run-time version of *Windows* with its product, and other developers are following suit. (At least initially, a runtime version of *Toolbook* plus an exemplary version of an application, *Daybook*, will be packaged with *Windows 3.0*.)

Even hardware manufacturers recognize the value of the *Windows 3.0* scene: Northgate Computer Systems Inc. in Minneapolis, MN, has announced it's including *Windows 3.0* along with every IBM compatible system it ships. "Not only is *Windows 3.0* a strong contender as the environment of choice for most users," predicts Art Lazere, who heads Northgate, "it's another step toward the ultimate system." That ultimate, easy-to-use system will be one a PC newcomer simply unpacks and plays, running the pre-loaded software and applications.

Beyond the hybrid software programs, new and more powerful, visually wonderful desktop presentation programs are coming soon: *Persuasion* from Aldus and *PowerPoint* from Microsoft.

And, then there are more powerful versions of programs which embraced GUI early, and truly brought users new capabilities, notably *PageMaker* from Aldus and *Pixie* from Zenographics Inc. in Irvin, CA. Already, innovative and fun users, such as K-Paul's Louisiana Kitchen, the home of effusive chef Paul

Prudhomme, has changed how it does business, even how it prints recipes, because of desktop publishing programs on the PC.

"For this audience of creative artists and designers *Windows 3.0* is more aesthetically appealing," explains Brainerd at Aldus, which has been enormously successful at bringing design tools to the design and publishing communities. Adds Brainerd, "the details in the graphical user interface are everything and Micro-

Once you learn how to work with simultaneous windows you can read about the procedure on one part of the screen and execute it on another

soft has paid a tremendous amount of attention to aesthetic value."

The glitter—the redesigned screens, polished user interface, and consistent look—ultimately will earn *Windows 3.0* its reputation. Screen fonts are now proportional, giving a more professional, polished look.

Dialog buttons, used for command input or scrolling, have a three-dimensional effect not unlike their real-world counterpart. Commands, supported by pull down menus and redundant mouse and keyboard combinations, let you hit the ground running. (Microsoft and several other developers continue to design *Windows 3.0* so it can be used without a mouse, thus giving users the choice between using mouse or keyboard commands at any given time.)

Furthermore, the interface neatly relies on icons to execute commands. This visual orientation decreases the distance between two points. Each program or file is represented by an icon and a double-mouse click loads the file and application at once. There's no need for the arcane or difficult character-based instruction set through which PC users have continuously suffered. With *Windows 3.0* files are controlled in a logical, visual manner.

Nor does this hybrid operating system arrive with an empty closet. In the beginning, Microsoft needed to demonstrate the system's abilities and included several mini-application programs as part of the package. Some of these, like *Clock*, *Cardfile*, *Calculator*, and *Calendar*, are rudimentary modules that add incremental power. Other "applets," however, provide true utility. *Windows Write*, *Terminal* and *Paintbrush* demonstrate a respectable level of text, communications and graphics power. These applications, in one form or another, have been with *Windows* since the beginning. For version 3.0, however, a macro module and an electronic version of Solitaire has been added to the stew.

A third category of *Windows* utilities zips up the system's efficiency. *Notepad* edits and saves text in ASCII format. The *PIF Editor* helps to incorporate standard DOS programs into the *Windows* environment. In addition, text and data transferable between *Windows* and non-*Windows* applications.

New to Version 3.0, the Recorder macro module saves and replays an unlimited amount of commonly used keystrokes for replay within any *Windows* program. This can be as simple as the inclusion of boilerplate text to a complex spreadsheet recalc or data base sort. When the glitter fades, Recorder may become one of *Windows*' most significant capabilities due to its ability to streamline and automate routine tasks.

WHAT YOU GET IS WHAT YOU SEE

Upon installation, *Windows 3.0* places all of the resident functions into groups. The "Main" group contains all of the system functions. "Accessories" features the mini-applications that add some value and initial functionality to the *Windows* environment. The "Games" group features Solitaire and Reversi. The "Windows Applications" group gathers all of the programs that run under *Windows*, while the "Non-Windows Applications" groups all those applications in one accessible place.

File Manager replaces *Windows 2.x* graphically stunted MS-DOS Executive as the environment's visible face. It coordinates and controls all functions, acting as a sort of traffic cop for the *Windows* environment. Its "Window" command manipulates the views and selects the various groups. Its installed configuration, however, is intended as a suggestion and only hints at *Windows*' power and versatility. The Program Manager allows the creation of user-defined groups and files, and the ability to assemble a workgroup—generally, a separate multifile, multiapplication table devoted to a particular task, will be seen as one of *Windows 3.0* most potent functions.

Windows' "Main" application group includes a sextet of functions that, with varying utilities, control the complexion of the environment. Some functions govern necessary file and system tasks, while others supervise customization both from a functional and environmental standpoint. The Main Six, in alphabetical order, are *Clipboard*, *Control Panel*, *DOS Prompt*, *File Manager*, *Print Manager* and *Windows Setup*.

The most important two for day-to-day operations, are the Control Panel, which oversees the subtleties of the *Windows* environment, and the File Manager, which controls and simplifies file and disk functions. In previous versions, *Windows*' Control Panel was a dreary little box that frustratingly needed periodic adjustment whenever the system was changed.

In *Windows 3.0*, the box is replaced by an iconic layout that lists its 10 functions in plain sight (the previous Control Panel wasn't so

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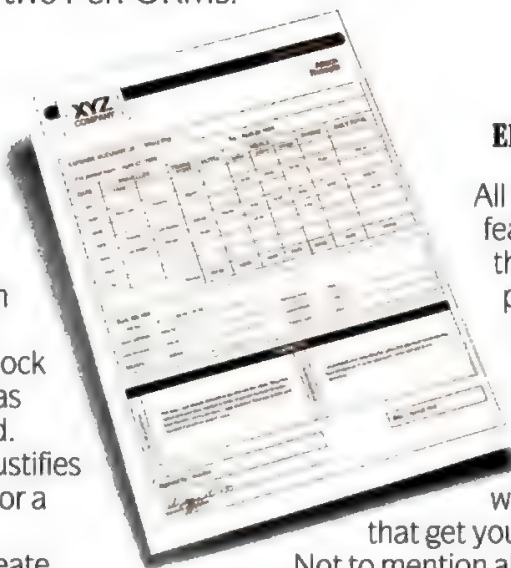
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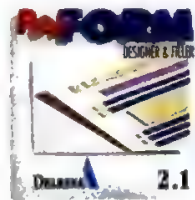
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FULFILLING THE PROMISE OF A GRAPHICAL ENVIRONMENT

continued

forthcoming). The usefulness varies, from necessities about port and printer interface to ways to "decorate" the desktop with the bitmapped image of your choice. Some users (and, certainly, consultants) may want to signatur their applications with the company's logo.

For the first time, the *Windows* 3.0 interface is specifically geared to multitasking with the task list, offering users an easy gauge of all the applications currently in use under the *Windows* umbrella. Accessible through the Control Menu box or with the Crtl-Esc toggle, the Task List itemizes each open file with application and file name—one of which will always be the Program Manager.

In typical *Windows* fashion, there is more than one way to execute the application switch from the Task List. You can double click on a highlighted option, click on the Switch To button (or hit the Alt-S highlight) or move to the choice with the arrow keys and press Return.

The Task List is not restricted to *Windows*

applications, rather it is probably the easiest method within *Windows* for skipping back and forth between *Windows* and DOS programs. In addition, the Task List has a facility to close an application, tile and cascade windows or arrange icons.

**Once you learn how
to work with simultaneous
windows you can read
about the procedure on
one part of the screen
and execute it
on the other**

HELP IS ON THE WAY

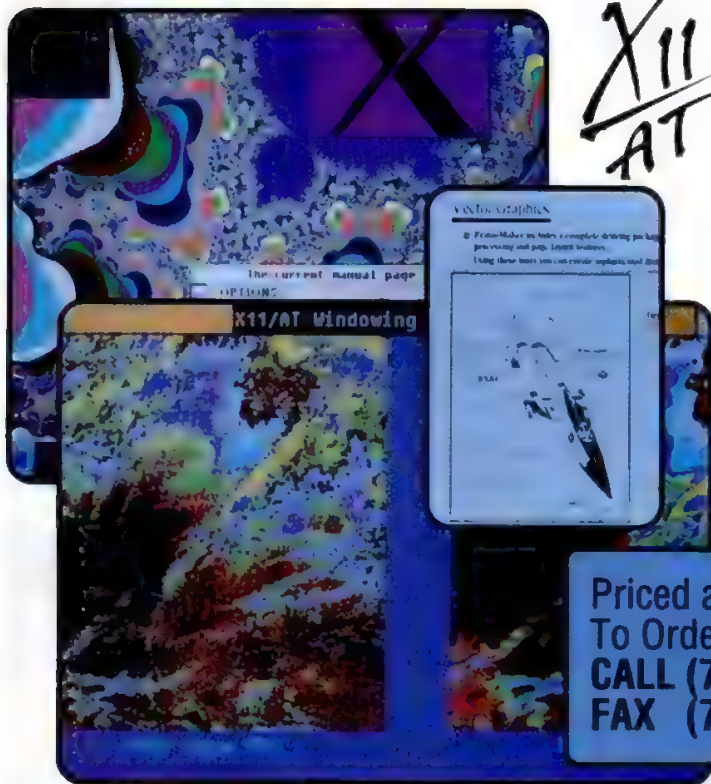
One of the most significant upgrades to *Windows* is the improved Help facility. Previously, *Windows* users were on their own when it came to uncovering the fine points and details of the system. Either that, or you could look it up in the (ultimately confusing) manual, distinguished by its four sections and four separate indexes. The redesigned *Windows* 3.0 manual not only has

one index, but is organized by a relatively understandable structure.

Windows Help, accessible through F1 or an omnipresent pull-down menu item, pertains to the specific application or module you are using; an independent application, like *Excel*, uses its own help file. The buttons within the Help facility, twice as big as those throughout "normal" *Windows* functions, offer Index and Search choices or the ability to browse forward, backward, or travel back one screen. Topics are listed in sequence, and a click upon the text topic brings up a detailed onscreen explanation. This is especially helpful. Once you learn how to work with simultaneous windows you can read about the procedure on one part of the screen and execute it on another.

Windows 3.0, then, is a product whose time has come. The synergy of hardware, software, installed base size, and user interest now combines to signal a common direction. And there seems to be few reasons not to take the newly landscaped *Windows* path.

This special advertising section was prepared by Connie Winkler & Associates.



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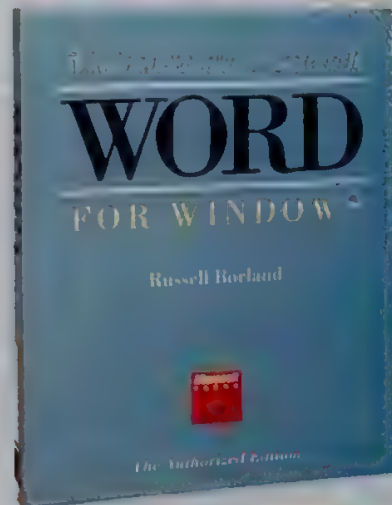


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MICROSOFT WINDOWS WAKES UP TO SOUND AND ANIMATION

Multimedia Applications Prepare for Life in the Spotlight

MacroMind's multimedia presentation software first ran on the Macintosh and will come to the PC through Windows 3.0

It's happening again. A confluence of maturing technologies is once more making a new application possible on PCs.

Like presentation graphics and desktop publishing before, multimedia is about to change the way people prepare and present data.

This heightened sense of possibility has been enthusiastically embraced by a growing group of creative developers who are excited by the newly attractive Windows 3.0 environment, including some who currently have product only for Apple's Macintosh computer.

The brightest light is MacroMind Inc., with *MacroMind Director*, multimedia presentation and animation program which interactively combines text, graphics, animation, audio, and video images at high quality.

"Graphics that move communicate more than graphics that stand still," tells Marc Canter, who founded MacroMind six years ago.

Microsoft to extend the multimedia capabilities of Windows 3.0, and with other developers such as Asymetrix Corp. to build animation links to other products and applications.

This switch-and-play capability is what users want, said John Scull, MacroMind president.

"Users will be able to take a scene or presentation developed on the Macintosh and play it back on a PC."

"An ideal playback instance might be in a business presentation or a PC-equipped demonstration kiosk", adds Scull. And the software is attractively priced at \$99.

"It took the combination of Windows 3.0, the concept of a base multimedia PC, and refinement of sound-synthesizer options to make the MacroMind connection real", said Canter, guiding light of the San Francisco software/studio.

"Until recently it has been impractical to run graphics and sound which require lots of memory", says Canter, who confessed he became expert at crashing a PC with his multimedia applications during the early phases of development—before he had Windows' 16MB memory space and 386 protected mode.

"For the first time", Canter said, "users see a strong reason for running 33Mhz systems", explains Canter. "It's because we are trying to move graphics and synchronize sound with animation—things directly affected by system speed and how big the hard disk is." Windows 3.0 on a 386 PC will use a hard disk to create virtual memory, taking an application far beyond the 16MB RAM limit.

METHOD TO MULTIMEDIA

For both MacroMind and Microsoft, the multimedia push has a method:

If the PC is to entice new users, it has to move beyond being a productivity tool to becoming an information tool—delivering fun and valuable knowledge to the home, initially at least, over CD-ROM media.

And, the mission of the Multimedia Systems Group at Microsoft and leader Rob Glaser, is to create the technology and synergy to bring multimedia PCs to every home.

Microsoft's goal is for "the PC to play a broader role, to become integral to everyone's life in a very fundamental way," said the multimedia general manager.

Foremost, this means making PC-based information tools visually and aesthetically compelling, and integrated into an environment so that users can flip between the information tool and other PC tasks. In this case, compelling means full sound and animation.

Since this challenge is broad, involving new technologies, new content, and new creativity, Microsoft is working openly and enthusiastically with more than a dozen bright technology, media, and training companies.

Although Windows 3.0 now includes hooks for multimedia systems, particularly Dynamic

Now in a runtime environment, MacroMind is making their playback software, *MacroMind Windows Player*, available on Windows 3.0-equipped PCs.

Importantly, MacroMind is also working with



MICROSOFT WINDOWS WAKES UP TO SOUND AND ANIMATION

continued

Data Link Libraries (DLL), the links need to be technically perfected for a range of technologies.

Needed improvements include advanced graphics and video compression, digital audio processors, music synthesizers, information streaming from the CD ROM to the PC, content authoring tools, and new storage techniques.

"The authoring tools are important so that not everyone has to be a C programmer to develop multimedia tools", continues Glaser.

NEW TOOLS

Two developers are breaking away fast from the starting gate with multimedia application development systems that anyone can use.

Toolbook from Asymetrix is an object-oriented programming language and a front end for existing data bases.

Spinnaker Plus from Spinnaker Software is a hypercard equivalent, that will also allow non-technical users to quickly assemble multimedia applications for others to use, simply by pointing and clicking at menu choices.

For proficient C programmers, object oriented tools that link into *Windows 3.0* will be still more powerful.

Hewlett Packard Company's *NewWave* is a platform that allows such programs to operate in a completely graphic way, providing a complete point-and-shoot atmosphere that will be accessible to any novice.

"*NewWave* should be able to use lots and lots of different information; in practice it hasn't been able to do that simply because of no memory," said Mike Webb, *NewWave* develop-

ment manager.

"The most exciting applications are the ability to drag-and-drop video or audio segments into existing documents—even from familiar formats like word processing documents or spreadsheet files", said Webb.

POWER TOOLS

In preparing these easy-to-use programs, coders will have to get increasingly sophisticated. Fortunately, the available tools will make that transition manageable.

CASE:W from CASEWORKS, Inc., in Atlanta, *Actor 2.0* from the Whitewater Group in Evanston, IL, and *ObjectView* from Matesys in Washington, DC are the leaders in helping C programmers master the 450 C functions that are part of the *Windows* platform.

Actor 2.0 from Whitewater takes the object-oriented approach to programming in the *Windows* environment. "A major benefit of object-oriented programming with *Actor* is that its predefined classes reduce the amount of code programmers need to write," said Jeff Wiss at Whitewater. Among the 125 *Actor* classes for windowing, graphics and data management capabilities, Whitewater has recently added *Windows*-like menus and dialog boxes, print formatting, graphics printing support, and time/date arithmetic. *Actor's* runtime debugger catches errors that would have been fatal in C.

To quickly produce the graphical user interface of *Windows 3.0* applications, *CASE:W 3.0* prototypes and generates source code, allowing the developer to animate the interface and test the look-and-feel of the program, without going through the lengthy compile.

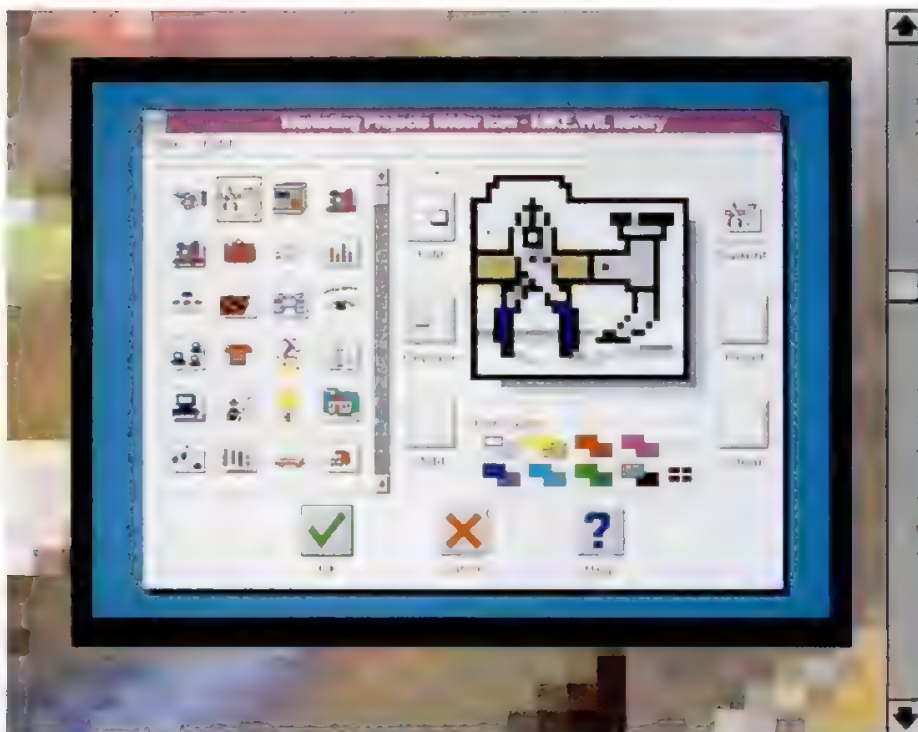
ObjectView lets programmers quickly define screens and graphics *Windows* functions and then link those directly to SQL data bases. The WYSIWYG graphic screen editor enables programmers and experienced users to create pop-up menus, edit boxes, check boxes, and graphic tablets, similar to *Excel*.

A companion Program, *ObjectScript* (\$150 for C; \$300 for Pascal) is a visual command system for *Windows* that company marketing manager Christel Van Den Eynden calls "a big batch language."

With *ObjectScript* a programmer—or a user—can create any command sequence within *Windows* and tie it to a button or other graphical cue. "With *ObjectScript* a user can create an interface that reflects exactly what they want," said Van Den Eynden. "Then they can give it to a programmer to do the real work."

Clearly, the road to multimedia applications is only now being charted. Thousands of programmer-hours will need to be spent in creating the exciting knowledge machines that we'll be enjoying in coming years. Thanks to these tools, though, the chance to create that future is open to anyone.

Toolbook will make
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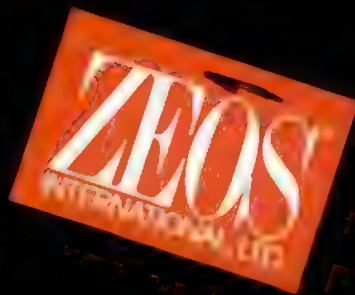
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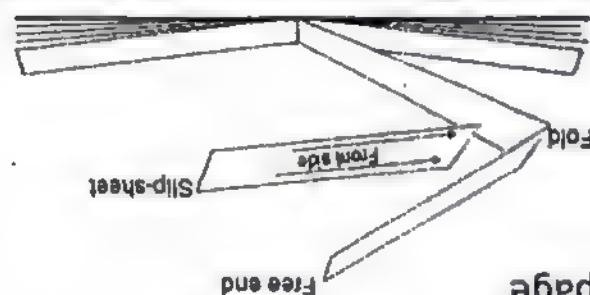
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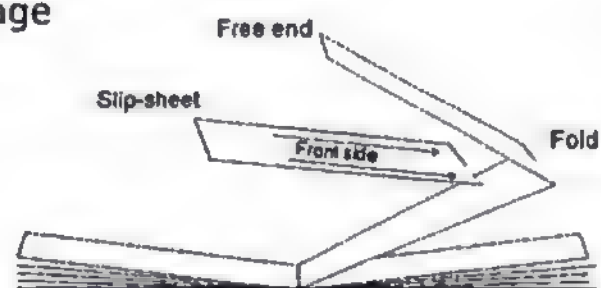
1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet



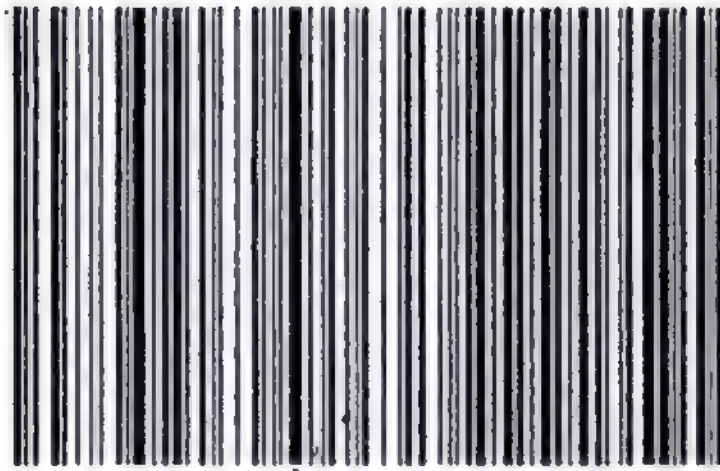
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
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1. Follow instructions on the other side

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Back

1. Follow instructions on the other side

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These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

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Reason #3

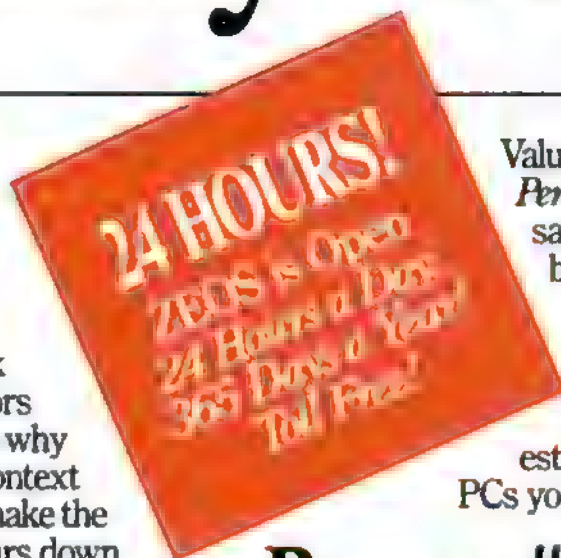
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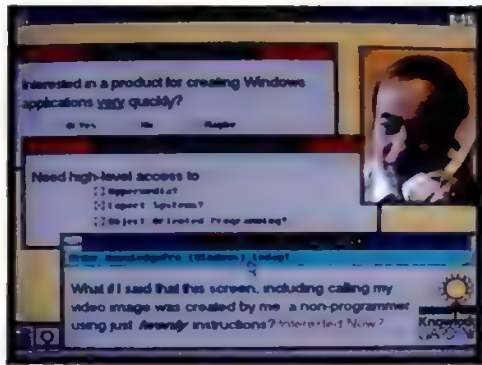
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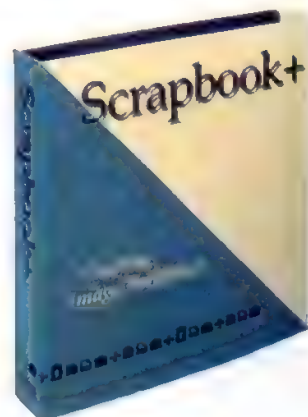
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WINDOWS 3.0 MAKES FAMILIAR APPLICATIONS EASIER TO MANAGE

Improvements to the Windows Core Give Applications A Performance Boost

The minute that Microsoft made *Windows 3.0* available, a raft of truly third-generation products that take advantage of the technical leaps in *Windows 3.0* immediately became available, catapulting users into new functionality in graphics, presentations, and desktop publishing.

"The beauty of *Windows 3.0* for business presentation software", said consultant William Coggshall, "is that it handles the 'heavy lifting' so that the graphics products can be tighter, less unwieldy programs."

Existing programs which snappily prepare business presentations are all poised with new releases that grab *Windows 3.0* benefits, added Coggshall, who publishes the *Desktop Presentations Report* newsletter in Mountain View, CA.

And, several newcomers are expected, including Microsoft's own *PowerPoint*. Until the

Arts & Letters can make screen calculations in the background while allowing users to work on images in the foreground.



unveiling of *Windows 3.0*, Microsoft's *PowerPoint* was only available on the Apple Macintosh. Also, currently only on the Mac is Aldus Corp's *Persuasion*, but a PC version also is expected by the end of year. "Having *Persua-*

sion on two platforms opens up additional options for users", tells president Paul Brainerd at Aldus.

Another PC-Macintosh presentation program is *Pixie* from Zenographics, Inc. in Irvine, CA. *Pixie* is a charting and drawing package especially for presentation graphics—full-color slides, hardcopy, or overhead transparencies. By calling *Windows 3.0* Dynamic Data Entry (DDE), *Pixie* will be able to work in tandem with another application, sharing data behind the scenes.

Closely linked to the challenge of preparing presentations is printer output, an increasingly complicated, and too frequently befuddling art. Precisely because of that shortfall between what users want to do easily and what the technology allows, a host of complementary products have arisen—and more are expected. *SuperPrint*, again from Zenographics for *Windows 3.0*, reduces to 2 to 4 minutes, a printing task under *Windows 3.0* that might take as long as 20 minutes without *SuperPrint*'s rasterizing, explained Lane Freestone, a product manager at Zenographics. The stakes get much higher with business presentations which might take as long as 18 hours to produce an entire sales presentation.

GRAPHICS GLITZ

If a little graphics glitz and color enlivens any software program, just think what a lot of multi-colored glitz will do. Take *Micrografx Designer 3.0*, for example:

Micrografx's \$695 retail program is a professional illustration tool that creates and manipulates images in the same way that a powerful word processor does text. As a professional level graphics program, *Designer* can create complex images and integrate them into the *Windows* environment, or transfer them to desktop publishing or other projects.

Since graphics designs by nature hog memory, illustration power is enhanced by access to more RAM through *Windows 3.0*. *Micrografx* claims the package runs up to 14 times faster when given adequate memory access. This fuller memory accessibility supports features such as color separation and electronic slideshow capabilities—these features are both key to the growing business presentation applications. In addition, 1,700 clip-art images are included.

Although *Designer* itself is not a computer-aided-design (CAD) package, it can be used in conjunction with CAD packages such as *Autodesk*. According to *Micrografx* chief executive Paul Grayson, many companies need to polish both their external and internal documents. In cases where image is important, it's essential to get the message across. To enhance the text message they add forms, flow charts, and organizational charts.

Meanwhile, Corel Software in Ottawa, Can-



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WINDOWS 3.0 MAKES FAMILIAR APPLICATIONS EASIER TO MANAGE

continued

ada, is expected to have a *Windows 3.0* friendly *CorelDraw! 3.0*, adding a faster automatic tracing feature. Various upgrade options will be available on the \$595 professional graphics and illustration program, said Jennifer Poulsen at Corel.

Today's sophisticated users want to brighten their messages further with color from color printers and plotters. And those who can't afford the hardware might send the image, by modem or disk, to a processing service bureau to be processed into a slide.

Also planning a *Windows 3.0* version is Computer Support Corp. in Dallas, with its popular *Arts & Letters Composer*. The new *Arts & Letters* should ship within 30 days of Microsoft's formal announcement, said Gail McCannon at the company. *Arts & Letters Composer* for the PC is a popular, giant clip-art library of 3,700 images and dozens of outline typefaces, which users can apply in business presentations and desktop publishing projects. The multi-tasking allows *Windows 3.0* to perform screen redrawing in the background, while the user works on the screen. Computer Support's technology enables users to print variously sized and designed clip-art images to any dot-matrix, laser, or PostScript-equipped printer.

DESKTOP PUBLISHING

If like *VisiCalcon* the Apple II and *Lotus 1-2-3* on the IBM PC, Aldus' *PageMaker* is the application that sold early *Windows* for many visionary users, then *Pagemaker* and other comers are truly going to blossom.

One user who went "ga-ga" over the newly

powerful desktop publishing systems is Sean O'Meara, who does data processing for K-Paul's Louisiana Kitchen. Previously, the staff at the New Orleans restaurant used to spend up to \$100 per recipe getting the recipe typed, set in type, and corrected. Now all the work is done on PCs running both *Ventura Publisher* and *PageMaker* as well as a variety of font add-ons.

"It looks better than what comes off most Macintoshes," tells O'Meara, "and the process is certainly more cost-effective". The computer group also prepares newsletters and additional sales information for K-Paul's distributors and restaurants.

But the serendipity—or *lagniappe*, in Cajun style—is that the publishing system and documents can be linked to *Microsoft Excel*, along with other programs on the PCs. And O'Meara has already set up the downloading of general data from the company's minicomputer, an IBM System/36, to the *Excel* spreadsheets for additional analysis.

It's a natural that *PageMaker* will run under *Windows 3.0*, but while Aldus promises a new version to maximize that availability, the company won't commit to when it will be ready. Also uncertain is how current *PageMaker* users will acquire upgrades. For now, users who upgrade to *Windows 3.0* will be able to run *PageMaker 3.0* by running the new *Windows* in real mode, instead of the more exciting protected mode.

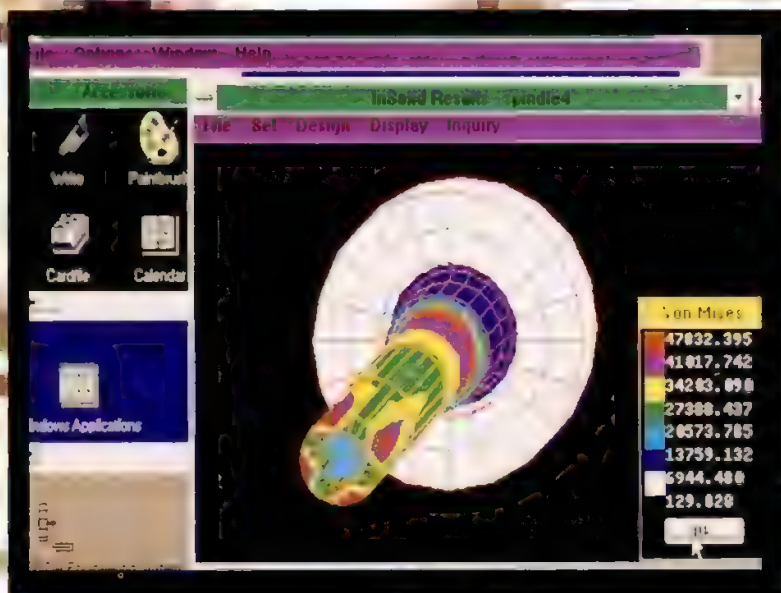
Aldus in Seattle is working in conjunction with Microsoft to develop a fully-*Windows 3.0* compatible *PageMaker*, said Brainerd. Thirty days before the product is ready to ship Aldus will announce it, he added, and it will also be available in Europe 30 to 45 days after the U.S. "We were the first major application to run under *Windows*, even including Microsoft's own *Excel* (spreadsheet)," told Brainerd.

"*PageMaker* was the first major application that showed why a graphical user interface was important on the PC," said the Aldus leader, who finds that Aldus' artsy customers approve the use of proportional fonts, dialog box, and color. "The (improved) aesthetic value is appealing to our customers," continued Brainerd.

"When designers and editors commonly work as a team, networking is a key factor to increased productivity. With the *Windows 3.0* version, *Pagemaker* users will readily be able to share files and printers, including powerful PostScript printers," said Brainerd.

Surely, one product that will never be the same after *Windows 3.0* is *Ventura Publisher's* Gold Series PC publishing system. "The new *Ventura Professional* is a ground-up reworking of the publishing package, not a subterfuge or hiding of the existing GEM-based product," tells Ann Galdos, a Ventura product manager for Xerox's Desktop Systems in San Diego, CA. "We're committed to delivering the new *Ventura* within 60 days of the Microsoft announcement," she added.

Foresight Resources designed their original version of *Windows Dratix* with features that would easily hook into the new version of *Windows*.



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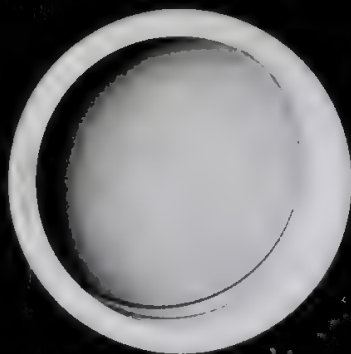
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And, notes Rich Abel at Microsoft, underscoring *Windows 3.0* vitality and competitiveness, *Ventura* is one of several products that have come over to the *Windows 3.0* environment because of this announcement. Abel is group product manager for *Windows*.

The availability of color and adoption of the *Windows* graphical interface, are the most apparent changes for the new *Ventura*. But, the real power will come from the breaking-the 640K barrier memory management in *Windows 3.0*. Users will naturally handle larger documents. Especially the powerful memory management applied to desktop publishing means, according to Ventura's Galdos, "The GEM product ran out of gas; it's going to remain as we know it today."

And, for sheer practicality, *Windows 3.0* will dramatically ease how *Ventura* supports the ever growing and varying numbers of monitors. By example, tells Galdos, in the existing GEM version of *Ventura*, 18 of the 20 low-density diskettes the product comes on are devoted to device drivers. The new *Ventura* will also take

advantage of *Window's* improved mouse scroll functions, much enlarged clipboard, and improved cut-and-paste between documents.

Adds Galdos about the beta testers on the new *Ventura*, "We're on a honeymoon—they're seeing it in color." (Xerox also shortly plans a *Windows 3.0* capable version of *FormBase*, its graphical database and forms processor, which is popularly linked to other applications.

DESKTOP ENGINEERING—BREAKING LIMITATIONS AND SPEEDS

Nowhere is access to adequate memory more important than with drafting and engineering software products, which require lots of memory and lots of processing power to present detailed engineering drawings. Several programs which grab those intensified capabilities through *Windows 3.0* include:

■ *Inertia 3.1*, a computer-aided-engineering (CAE) simulation program from Modern Computer Aided Engineering, Inc. (MCAE)

■ *Drafix Windows CAD 1.1* from Foresight Resources Corp, a low-end drafting program, which is turning up as another tool—along with the project manager, spreadsheet, and word processor—on an increasing number of professional desktops.

■ *Design/IDEF(R)* and *Design/OA(R)*, computer-aided system modeling tools from Meta

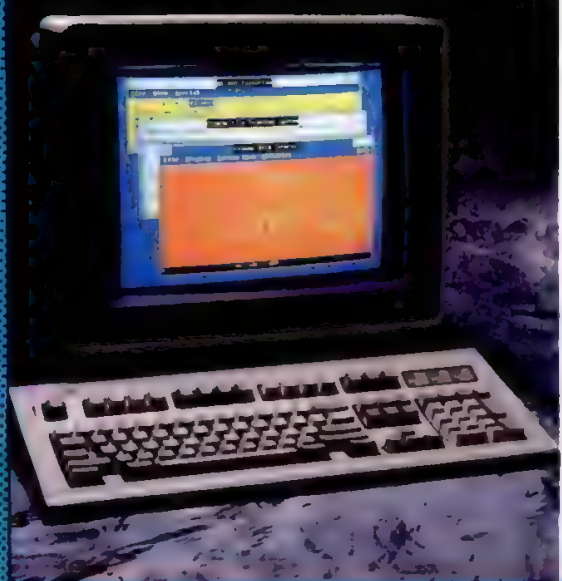
Software Corp.

"A lot of people don't even know you can do CAD on *Windows* or that there's [now] a way to break the 640K barrier," reports August Grasis, president of Foresight Resources Corp. in Kansas City, MO. "Because *Windows 3.0* runs in protected mode supported by the 80286, 80386, and 80486 chips, applications can address extended memory. This allows *Drafix Windows 1.1* users to create larger drawing files and improve performance dramatically," said Grasis. Beyond memory management, *Drafix* and all the drawing/engineering programs also benefit from the longer list of high resolution graphics displays supported.

An annoying limitation of most PC CAD programs is that the slightest alteration requires a slow redraw time, freezing the menu and cursor. With *Windows 3.0* and *Drafix 1.1*, that drawing regeneration takes place in the background, allowing users to be more productive by continuing their drawing and editing.

Being late in entering the PC CAD marketplace, Foresight took more of an advantage of the *Windows 3.0* features. *Drafix Windows CAD* ran under *Windows 2.0*, but that 1.0 product was introduced late in July 1989. Since Foresight knew of *Windows 3.0* features, their product was designed to hook those new features as they became available. (*Drafix 1.0* users

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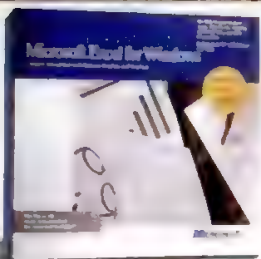


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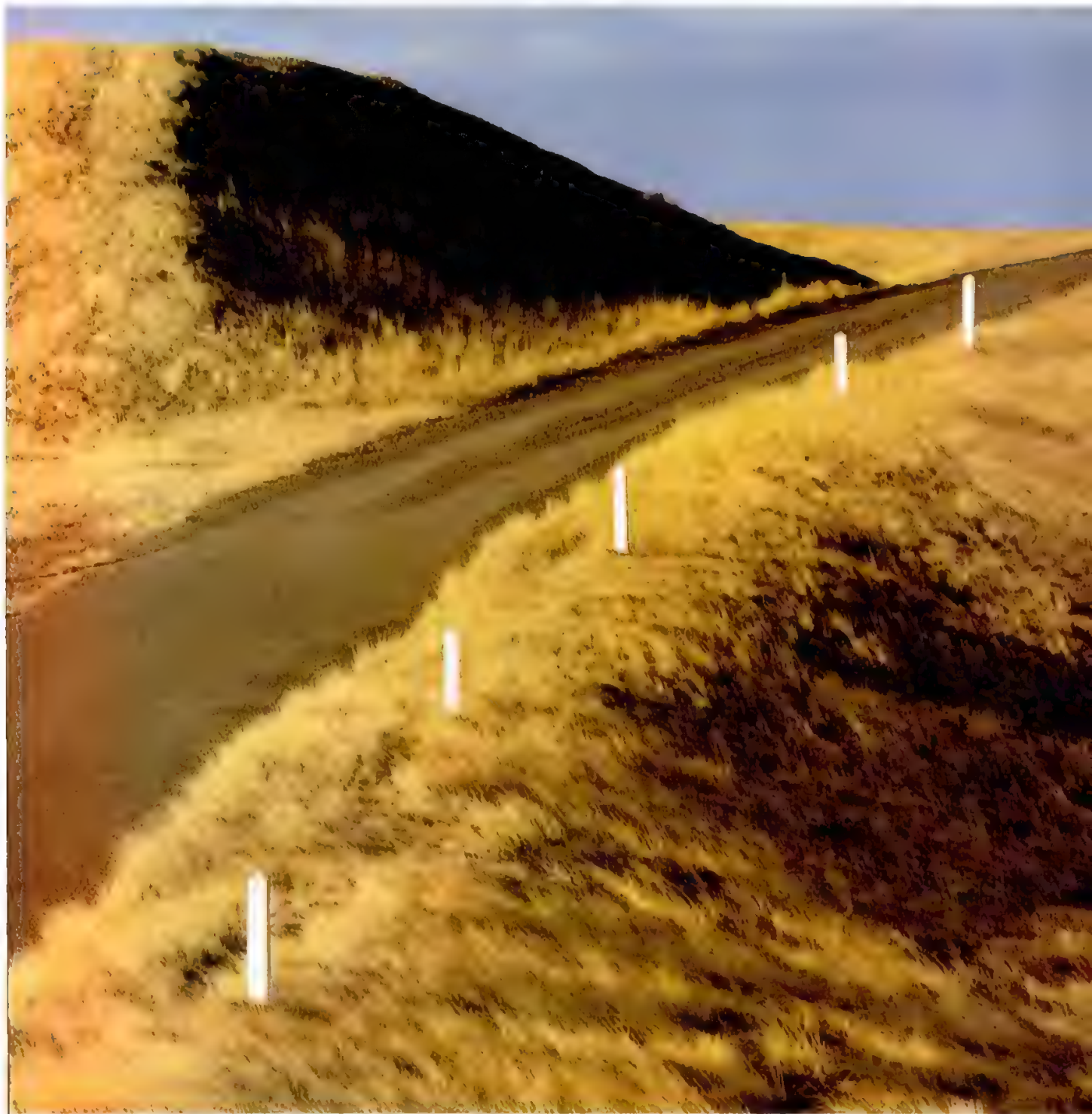
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CIRCLE 174 ON READER SERVICE CARD

WINDOWS 3.0 MAKES FAMILIAR APPLICATIONS EASIER TO MANAGE

continued

receive a free upgrade through July 1.)

Since *Drafix* at \$695 is a less expensive, or what the industry designates as a low-end, product, Foresight has found its market expanding rapidly—especially with the recent blast of Intel 80386-based, speedy processors.

PC-based CAD systems are no longer expensive. Dedicated CAD workstations are used by architects and engineers. Simple CAD programs are becoming an added tool in the professionals' computer portfolio—along with spreadsheet and word processing tools. Customers for these simple CAD systems are either individuals in small businesses who can't afford the more sophisticated programs, or professionals in larger organizations who are outside drafting rooms, but still need CAD capability for portions of their work: technical writers, facilities and office managers, or even toy designers fit here.

"And", adds Grasis, "when CAD is only an occasionally used tool, then it's more important than ever for the commonality of interfaces that *Windows* 3.0 provides. Users simply don't have

time or the ability to remember confusing commands, which vary from program to program."

DESKTOP MODELING

"Because of *Windows* 3.0, the only limit on (computational) model size is the computer's hard disk," said Douglas S. Curry at MCAE headquarters in West Lafayette, IN, adding that *Inertia* is a popular engineering simulation program, which in informal tests and customers' reports exceeds similar products which run on

Simple CAD programs are becoming an added tool for the professionals' computer portfolio

minicomputers and mainframes. As distinct from computer-aided-drafting (CAD) programs which produce a picture/image of the desired object, computer-aided-engineering (CAE) programs use computer modeling to test whether the desired object will work, or can be built.

"*Inertia* will now be able to analyze larger finite element models than ever before because *Windows* 3.0 breaks the 640K memory barrier under DOS," continues Curry. "*Inertia* under *Windows* 3.0 will use all the computer's RAM, and on 80386 PCs access the hard drive through

virtual memory." For example, all the buildings at New York's World Trade Center could be modeled as one project under the latest *Inertia*, versus separate projects in the past.

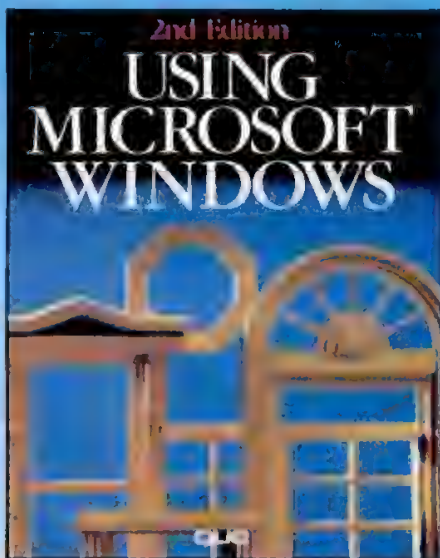
"More memory opens up all kinds of fun for our users," tells Curry. "It basically gives us mainframe computer performance on a micro." *Inertia* users seem to enjoy designing and running their latest engineering recipes so much that every month Curry receives 20 to 30 diskettes from excited users.

Two other power punches for *Inertia* as a result of the new *Windows* are the increased processing speed, and the much simplified learning curve for their product. *Inertia*'s analysis speed will jump dramatically, especially running under protected mode. And, the *Windows* 3.0 network manager supplies much greater efficiency for engineers, architects, and manufacturing designers who commonly work in groups, adds Curry. *Inertia* runs on other engineering workstations including the Apple Macintosh II series and from Sun Microsystems, Apollo/Hewlett-Packard Co., and Digital Equipment Corp. (DEC).

One of MCAE's unique positions as a company is the push to eliminate those ubiquitous "cumbersome and perplexing" user manuals, according to Khosrow Nematollahi, founder and president of MCAE, which was launched in

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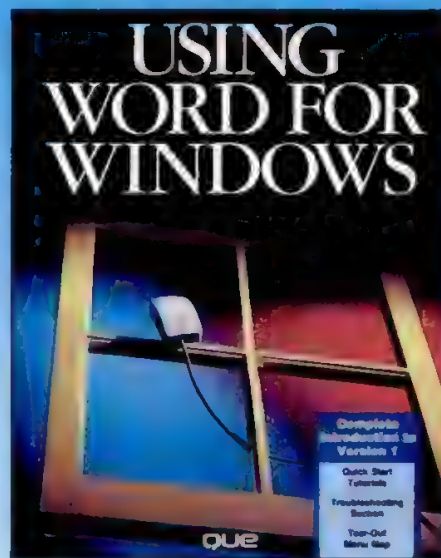


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WINDOWS 3.0 MAKES FAMILIAR APPLICATIONS EASIER TO MANAGE

continued

1985 with private funding from the state-sponsored Indiana Corporation for Science and Technology. MCAE introduces the engineer to the product through the same series of steps as if the project were being done without a computer.

GUI IMPRESSIVE

If there's one software maker who doesn't need to be sold on the merits of the graphical interfaces, it's Meta Software in Cambridge, MA. Meta with its Design/IDEF for Apple Computer's Macintosh has the leading engineering design tool for the Macintosh. (IDEF is a government-prescribed design standard.)

Design/IDEF is a computer-aided modeling tool which supports the creation of IDEF activity and data modes. Design/OA is a C language construction kit for the rapid prototyping and implementation of diagram-based applications. Both will be available under Windows 3.0 by this summer.

"Computer modeling is inherently graphical"—using diagrams and graphics to solve system

problems—so the graphical interface is totally appropriate", said Andrew V. Levin, Meta vice president. Furthermore, Windows 3.0 address the big, related needs for more memory to handle larger models, and at higher performance.

"It's not surprising to find complex models, 10-to-200 diagrams interleaved in hierarchies", Levin tells, "(before Windows 3.0) with such large models there was so much swapping of files, that the performance just wasn't acceptable." Users don't want to sit and watch the system "cogitate." Windows 3.0 also emphasizes the interactive nature of computing which turns out, appropriately, to mimic the computer modeling process.

NEW CHARTERS

Given the graphical power of Windows 3.0, scads of drawing and graphing tools are expected by current developers and newcomers.

"Flowcharting isn't just for programmers anymore. Corporate and government employees in all departments are using flowcharts to document procedures of any kind," tells Stuart Tunick, vice president of Roykore Inc. in San Francisco, CA. "ABC Flowcharter's features (under Windows 3.0) make it useful for a new set of applications from desktop presentations to on-line training programs."

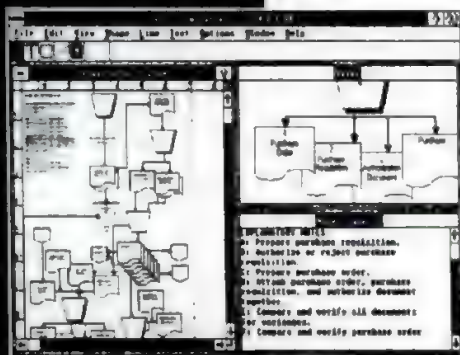
ABC Flowcharter, Roykore's \$295 chart-maker program, uses the point-and-click capabilities, greater font availability, multiple dimensions, and other Windows 3.0 functions to create up to 64-page charts. The neat trick in Flowcharter is multilevel documents explaining office procedures, for example. Users point to instructions on the screen; clicking on a shape brings up another chart showing the procedure in more detail.

Users can also attach notes to shapes that pop-up on the screen as needed—and then import the files to word processing or desktop publishing programs.

Users enter personnel information into customizable fields and ORGcharter 1.0 automatically draws the organization chart, letting users choose from seven different organization tree structures, various patterns and colors. In the easy to use program, positions are inserted or deleted by clicking the mouse on existing boxes. Also, employee information can be stored with managers clicking on the staff box to retrieve or review the relevant data.

"The problem with using drawing programs is that they don't automatically space and redraw charts when positions are inserted or deleted," said Tunick. "Users' expectation levels have rightfully risen to the point where they expect the software to do all the work."

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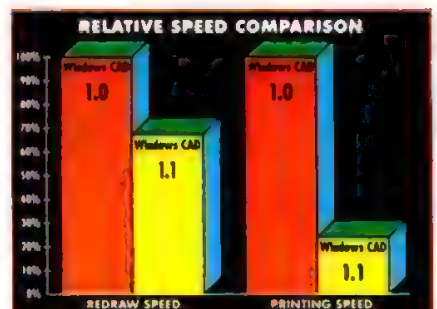
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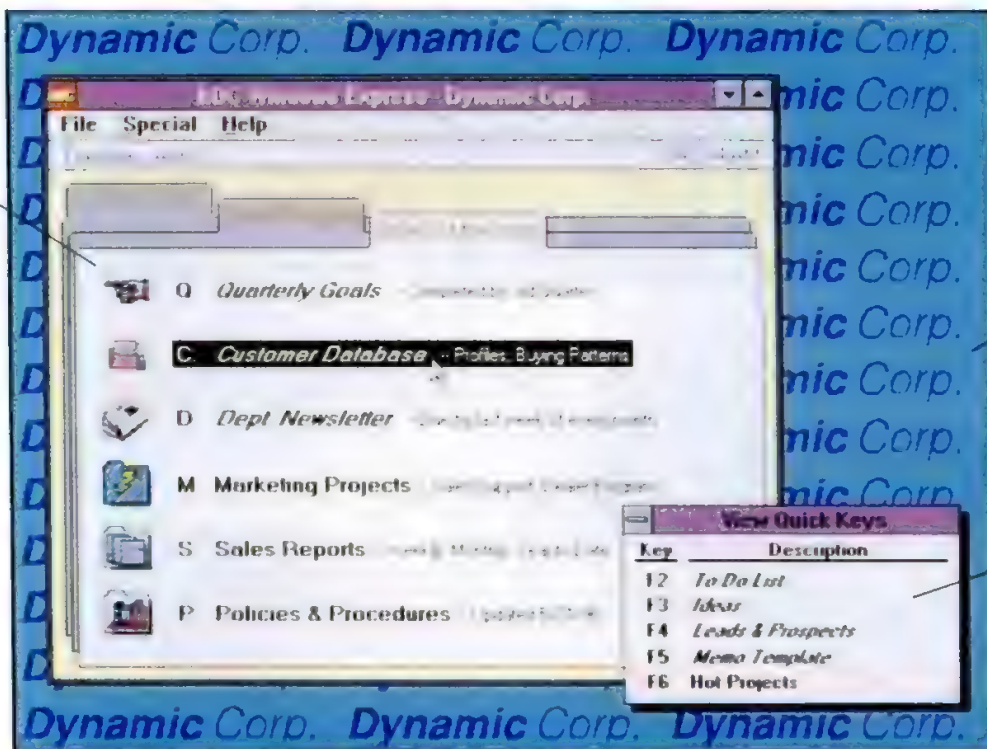
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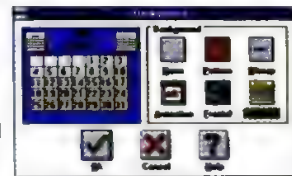
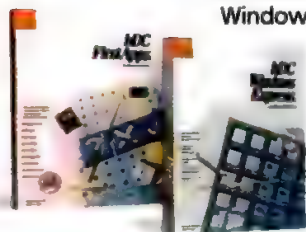
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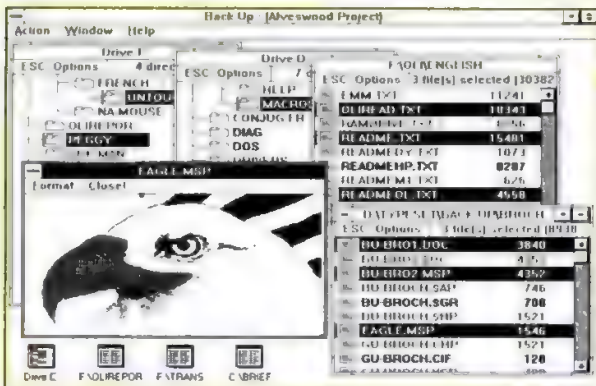
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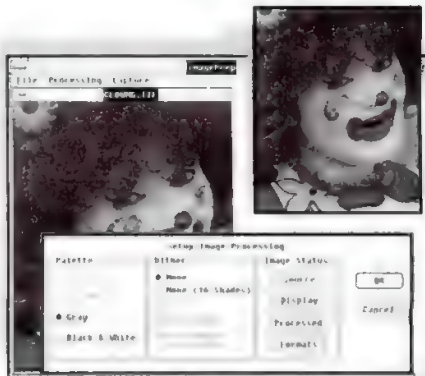
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- TGA - 24, 16, 8-Bit Color
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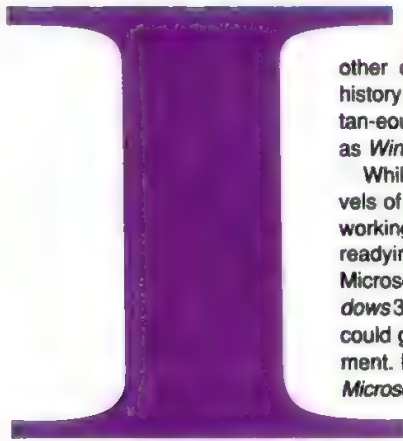


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NO DELAYS IN GETTING MOST WINDOWS UPGRADES UP AND RUNNING

Long Development Cycle Gave Windows Programmers a Chance to Make Good Programs Better



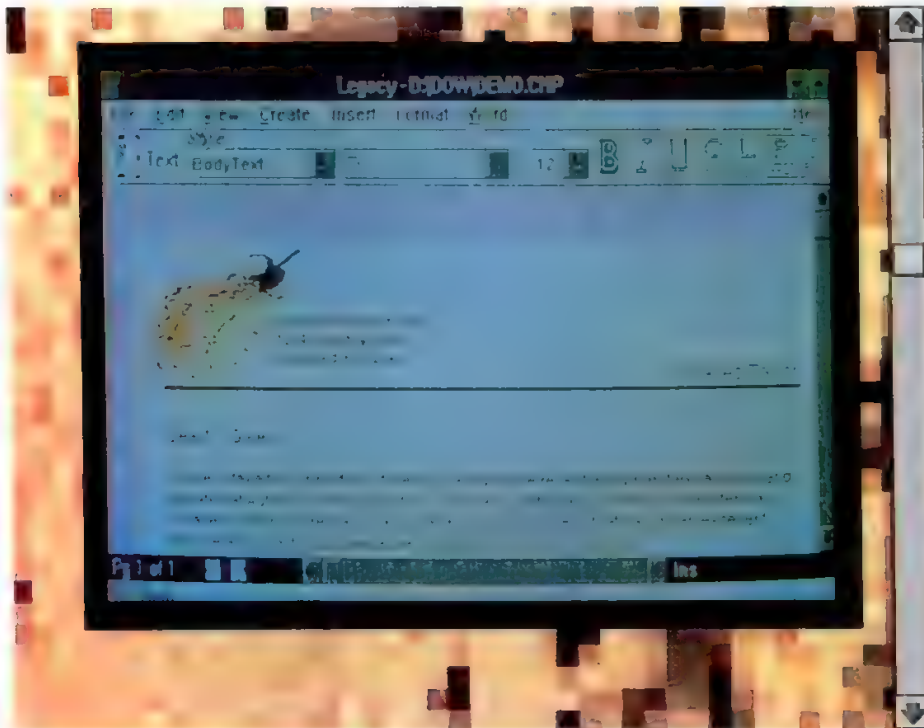
It's one for the history books. No other operating environment in computing history has been released to such an instantaneous outpouring of compatible software as *Windows 3.0*.

While users are just now seeing the marvels of *Windows 3.0*, developers have been working with the product for more than a year, readying their own applications and utilities. Microsoft made a big commitment to get *Windows 3.0* code to developers early so that they could get a strong start on product development. Rich Abel, group product manager for *Microsoft Windows*, explains: "We gave ample lead time to get commitment through action."

WIDER WORD PROCESSING

With *Windows 3.0* providing a third-generation operating environment, word processing systems, so long the staple on almost all PCs, are

Graphics from various sources can be merged with documents in *Legacy*.



also moving up in capability. At the forefront are Microsoft's own *Word for Windows*, a *Windows* specific version of *Microsoft Word* a heady comer from Samna Corp., *Ami Professional* and a new *Legacy* from NBI Inc.

Microsoft's *Word for Windows* (more affectionately known as *WinWord*) became available earlier this year and it was the first *Windows 3.0* compatible program on the market—long before Microsoft had publicly announced the new version of *Windows*, so *Word for Windows* users will immediately be able to run the program under the new environment and use all the memory their PC has installed. Later this year, Microsoft plans to offer some improvements to the word processor that will take advantage of some of the newer font management capabilities in *Windows 3.0*.

Samna Corp.'s latest version of its *Ami Professional* is ready to run under Hewlett Packard's *NewWave*, and gains the ability to integrate text from data bases or other word processors including Macintosh editors, or even, scanned or bit-mapped images from *Ami*'s resident drawing program.

"Compatibility with *Windows 3.0* gives our users the opportunity to employ new features such as 3-D push buttons, proportional system fonts and scroll bars to further enhance the on-screen look of *Ami Professional*," reported Samna Corp. president and chief executive officer, Said Mohammadioun.

"Unlike a *Windows* application that has been encapsulated to run under *NewWave*, *Ami Professional* has been built specifically with the *NewWave* environment in mind," reported Mohammadioun, adding that it's one of the first applications that has been designed specifically for *NewWave*.

Undoubtedly, this immediate entry of *Ami Professional* running under *Windows 3.0* eliminates any previous performance problems now that users have access to protected mode memory, notes *Ami* product manager Bill Jones. "Graphical user interfaces have always been limited because of performance," Jones said. "Version 3.0 makes *Windows* a simpler environment from a user and installation standpoint."

Not only is NBI (Boulder, CO) adding graphics and page layout features, to its word processor, the product is renamed: *Legend 2.0* is now *Legacy*. "Users no longer need to struggle with two separate programs to accomplish their day to day word processing and high-end document projects," said John Ball at NBI, referring to the WYSIWYG and page makeup features that have been reserved to desktop publishing programs. *Legacy*, available this summer, will be \$495, with upgrades initially \$100.

EXPANDING SPREADSHEETS

Since its 1986 introduction, *Microsoft Excel* has been a leading PC spreadsheet, and virtually the only choice for *Windows*. But it's about to face a challenge from *Wingz*, a powerful graphical spreadsheet from Informix of Lexana, KS. Microsoft's *Excel*, the first program that took advantage of *Windows*, in Version 2.1C is *Win-*

NO DELAYS IN GETTING MOST WINDOWS UPGRADES UP AND RUNNING

continued

dows 3.0 ready; that version shipped in February. Registered users with earlier versions can get a \$50 upgrade to the latest.

Wingz for Windows, a \$499 package expected by the end of June, 1990, features its own script language. Informix claims that any spreadsheet-savvy user will quickly be ready to create custom applications in *Wingz*. Users have control over all object buttons, slidebars, and even menus, and can take advantage of *Windows* 3.0 data links. *Wingz* works as a tra-

As the software load increases for traditional applications there, are only a handful of data base management systems grappling with the *Windows* environment

ditional spreadsheet, custom application, or as a front end to an SQL data base.

Wingz has over 140 built in functions and is a combination of *Hypercard* and *Excel*. Users will find that they can immediately create high quality graphics.

WIDE OPEN DATA BASES

Of all the *Windows* application categories, data bases are perhaps the weakest—but at the same time the most innovative. As the software load increases for traditional applications, there

are only a handful of data base management systems (DBMS) grappling with the *Windows* environment. Late last year Xerox Corp. announced *FormBase*, which combines a forms-making front end to a DBMS, having acquired the product from Columbia Software in Northridge, CA. And, the Xerox Desktop group also shortly plans a *Windows* 3.0 capable version of *FormBase*, its graphical database and forms processor, which is popularly linked to other applications.

Two other products tackling the new environment—and new thinking on how to store and retrieve information—are *Superbase 4* Version 1.2 (\$695, Precision Software, Richardson TX) and *Omni 5* (\$795, Blyth Software, Foster City, CA) combine database strength with graphical power. If these programs don't match such standbys as *Paradox* and *dBASE* feature for feature, they bring a new transparency to the hardest-to-learn software genus. Adding a visual dimension to record management itself increases computing muscle. Personnel management, where an employee's picture augments the work record, is one prime use. Real estate, law enforcement, and document storage are other obvious applications for visual representation.

Memory management is so important to inherently large data bases that *Access SQL* from Software Products immediately benefits from *Windows* 3.0, tells Kathleen Garvey, product manager at Software Products International in San Diego. *Access SQL*, which also makes use of forms to organize data, already operates under *Windows* and a new version will be available in July, Garvey said.

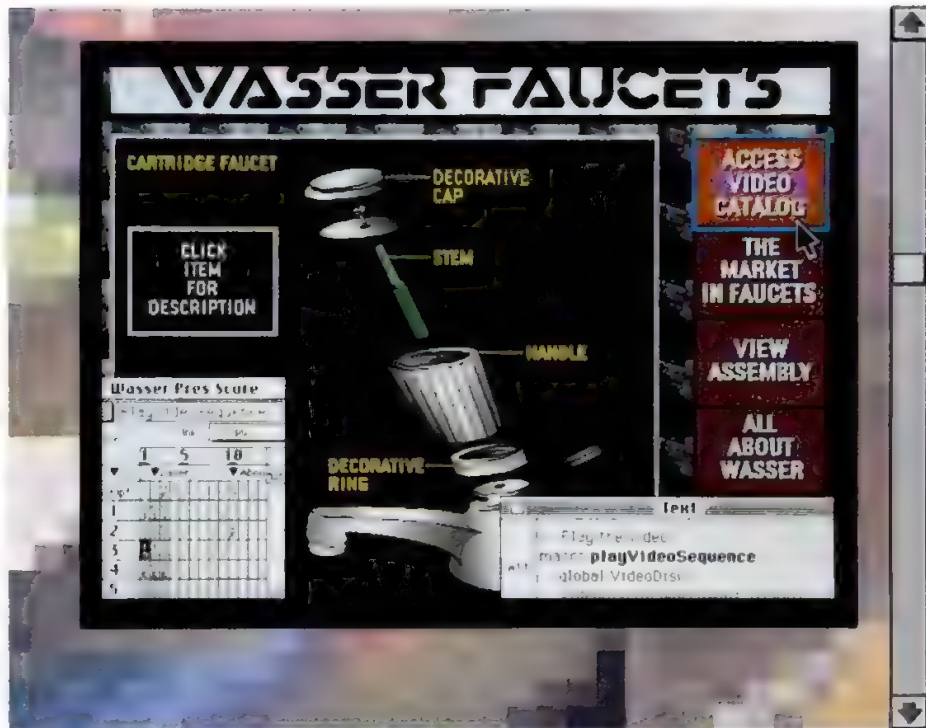
"Someone completely unfamiliar with *Access SQL* will find the graphical interface very intuitive," said Garvey, including internationally, where *Access SQL* is most successful. "Users will readily be able to 'drop' objects onto forms and make graphics changes."

Basically *Windows* 3.0 enhances all the *Access SQL* functions especially for multi-tasking, allowing users to design one report while another is printing out, for example. "If users aren't limited by memory, it's possible to have more than one application up on the system."

TIPS, TRICKS AND UTILITIES

With *Windows* 3.0's release, hDC of Redmond, WA, looked like the company most likely to fold its tent and go away. The company's previous products, *Windows* enhancement tools, supplied aspects to the environment that turned up as parts of the new system. For instance, hDC's color utility was rendered redundant by the *Windows* 3.0's sophisticated color selection module. Now, it appears that the company's previous enhancement products were just a dry run; hDC, named after a programming command, is getting serious. To complement *Windows* 3.0, hDC is rolling out upgrades and expansions of

hDC offers a variety of tools for organizing *Windows*' files and customizing the display.



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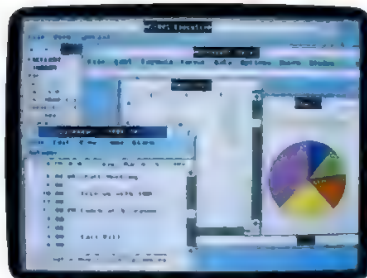
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Well, all of this was before new Microsoft® Windows™ version 3.0. A GUI environment that will forever transform the way you use your PC.

Now, before you wonder what to do with all of your existing DOS applications (to say nothing about your existing DOS experience), the Windows environment works within your MS-DOS system. This is not a traumatic thing.

As a matter of fact, once you see the environment created by Windows 3.0, you'll think quite the contrary.

The first time you see it, you won't believe it. Archaic characters, mundane instructions, and even entire command sequences, have been replaced by a program manager full of clear, friendly icons. You're immediately comfortable.

When you work on more than one thing at a time, you'll quickly reap the benefits. Because the program manager welcomes on-screen multitasking of large Windows applications. Of course, without ever visiting the “C” prompt.

Through something with the complicated name of Dynamic Data Ex-

change (DDE), you can simplify your life. For example, with DDE, you can change information in a Microsoft Excel spreadsheet, and have those changes automatically show up in a "linked" table in a word processing document. Or vice versa.



You can also easily access a network from within Windows. So, no matter how big the rivalry between research and accounting is on the softball field, everybody's on speaking terms in the office.

Even the setup program is graphical, only needing a few easy steps.

At this point, you probably think your machine will slow to a crawl the first time you try any of this.

We thought about that, too. So new Windows 3.0 breaks the 640K memory barrier that saddles other DOS programs. Giving you access to all the memory and power your 286 or 386 PC can muster.

It all sounds incredible. Which it is. And, it's taking place in an intuitive, consistent graphical environment.

For more information or to learn about upgrading your current Windows version, call (800) 323-3577, Dept. K85.

Graphics-based software is how people will run their PCs in the 1990s.

And there's no better way to get yourself acquainted than Windows 3.0.

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Microsoft Windows 3.0 is optimized for 1-2MB 286 and 386 personal computers. 640K RAM required. Customers inside the 50 United States call (800) 323-3577, Dept. K85. In Canada, call (416) 673-7638. Outside the U.S. and Canada, call (206) 882-8661. © 1990 Microsoft Corporation. All rights reserved. Microsoft, MS-DOS and the Microsoft logo are registered trademarks and Making it all make sense and Windows are trademarks of Microsoft Corporation.



NO DELAYS IN GETTING MOST WINDOWS UPGRADES UP AND RUNNING

continued

its most popular Version 2.x products. The upgraded *Windows Express* and renamed *FirstApps* (formerly *Windows Manager*) make the new environment customizable and adds the utility that Microsoft necessarily omitted.

"Now, we have a great operating system. We don't need to enhance the system as much, and can concentrate on providing utilities of the DOS market into the *Windows* market," said Connie Waite, hDC director of marketing communications. In fact, many of hDC's features are plain fun—and certainly colorful.

Since its 1986 introduction Microsoft Excel has been a leading spreadsheet, and virtually the only choice for the PC

The most noticeable improvements to *Windows 3.0* are its interface, sculpted buttons, and an iconic layout that makes it easier to execute commands and manage files. The \$99.95 *Windows Express* menuing program makes further strides, both spiffing up the icons and organizing them into a much more reasonable structure. Using a file folder visual motif, icons and applications are set up as members of common-sense categories. *Windows Express* arrives out of the package with a standard selection of folders and menu suggestions, but users can quite easily customize this interface to

accommodate their individual needs.

As with DOS, many of the most valuable *Windows 3.0* utilities control disk and file management—including *Desktop Office*, from Publishing Technologies of Austin, TX. *Desktop Office*—new for *Windows 3.0*—brings to *Windows* some of the capabilities that DOS users take for granted, while boosting the icon and visual power of *Windows 3.0*.

With DOS shells users, it will design an integrated way to command multiple applications. Since *Windows 3.0* already handles multi-tasking, however, what's additionally needed is a control for programs that work together rather than in parallel.

Thus, *Desktop Office* groups all active applications onto a customizable desktop, more closely resembling the Macintosh system than the standard *Windows* setup. To maximize flexibility, users access regular application programs in several ways: through an icon, a pull down menu or a speed key. In carrying pliability beyond that offered by *Windows 3.0*, users can customize the text that accompanies the desktop icons.

Although *Windows 3.0* offers a hospitable way to switch to DOS programs, the full-time *Windows* user will shortly begin to resent these intrusions. *Desktop Office*, with its standard DOS-shell characteristics, makes these jumps less necessary. It has a file undelete feature, along with selective backup and restore capabilities and presents files in a more detailed tree structure than *Windows File Manager*. The program's search facility finds files by name or text strings within that file.

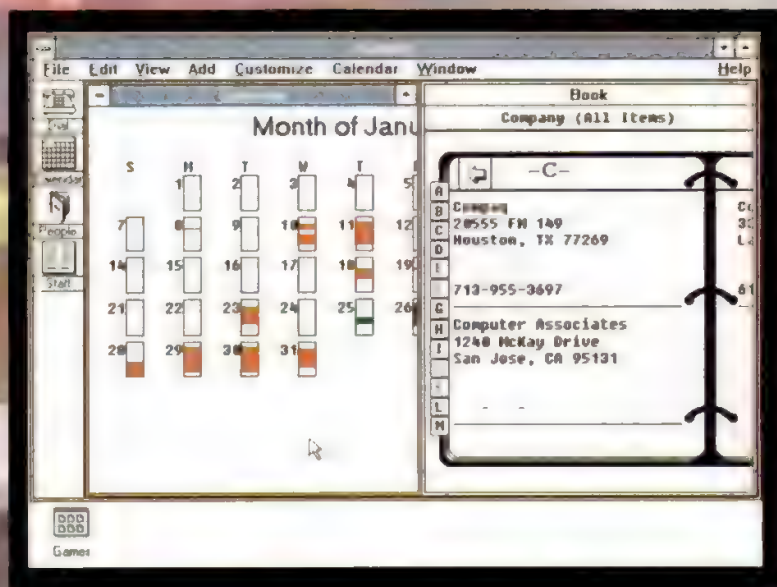
The program sorts files and directories with regard to a folder and icon motif. Icons are developed from several sources, *Desktop Office* includes a library of custom icons, along with the ability to modify or create them by using *Windows Paintbrush*. The program also adds the "Garbage Can" image for file deletion, one that makes sense (and has been part of the Apple environment for years).

PC COMMUNICATIONS

While PC-to-PC async communications programs don't, on the surface, appear to require lots of bells and whistles, the behind-the-screen benefits of *Windows 3.0* bring new dimension to several 3.0 compatible products. Futuresoft Engineering Inc. in Houston, with *DynaComm* and old favorite *Crosstalk* have new acts for the *Windows 3.0* stage.

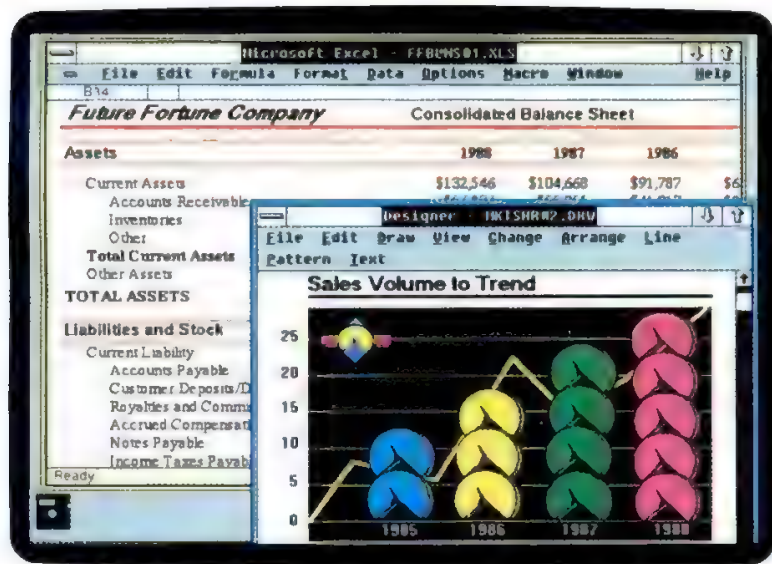
DynaComm 3.0, the \$295 communications package from Futuresoft Engineering Inc., uses the visual aspects of the *Windows 3.0* environment to enhance the transfer of files and information between computers. The program is the big brother of *Windows 3.0* resident terminal program, which Futuresoft developed and licensed to Microsoft for inclusion in *Windows 3.0*. *DynaComm*'s iconic interface makes com-

IBM's *Current* was already heavily dependent on icons in an earlier version. With *Windows 3.0*, *Current*'s design seems right at home.



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CIRCLE 292 ON READER SERVICE CARD

continued

"These days, everyone has a mixed shop," Bigham said. "But an organization that has a number of different machines can still standardize on the *DynaComm* interface and use the same scripting language. Corporate information supports one standard, not six." Beyond

Crosstalk benefits from *Windows 3.0*. The biggest request from users has been for added communications ports, and through *Windows*

A PC seems like it should be the perfect tool for organizing the diverse numbers and words that put structure into our life. Yet no software developer has yet found a formula that captures the

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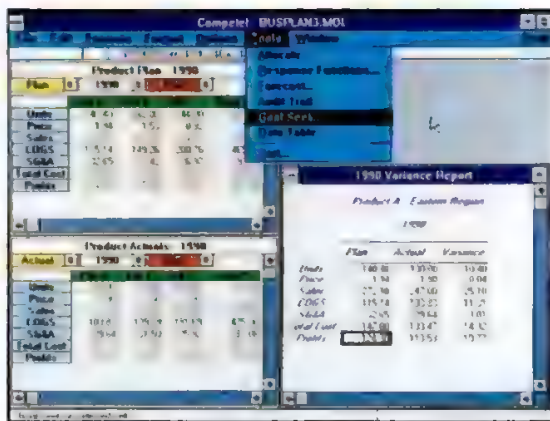
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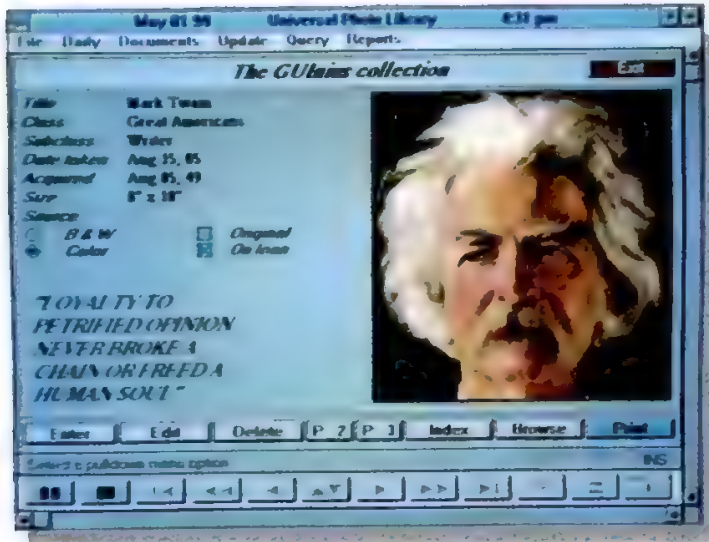
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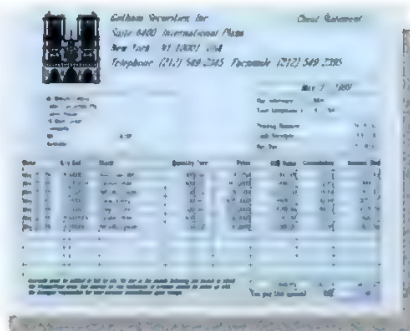
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NO DELAYS IN GETTING MOST WINDOWS PROGRAMS UP AND RUNNING

continued

imagination of most PC users who're ready to try a personal information manager.

"Each company with a product in this category has their own definitions," said IBM's Carmine J. Cordella, manager of PIM and Office Vision products, based in Milford, CT. "We wanted to take the very best features from them all. One reviewer said that *Current* is a combination of *SideKick* and *Agenda*, that's exactly the goal we tried to achieve," offers Cordella, referring to the popular products from Borland International and Lotus Development Corp., respectively.

Beyond the occasional resolve all of us have to get organized, the real value to PIMS may come when they're available over a company's internal messaging systems, either local or wide area networks, thus sharing schedules with co-workers.

A hookup to IBM's mainframe-based electronic messaging systems, PROFS is planned, whereby *Current* will become a more robust network solution, said Cordella.

Packrat 3.0, from Polaris Software, San Diego, CA, already has a Network Manager LAN version. Despite the definition and network issues, however, PIMS remain surprisingly seductive products.

Both IBM's *Current* and Polaris Software's *Packrat* 3.0 use *Windows* 3.0 as the occasion for a major upgrade. While at \$395, *Current* and *Packrat* cost considerably more than what one may expect to pay for something that is not a "primary" application, the danger here is read-

**Beyond the occasional resolve
all of us have to get
organized, the real
value to PIMS may
come when the're available
over a company's internal
messaging systems...**

ing the book by the cover.

Polaris, which has shipped its own *Microsoft Windows* 3.0-capable program since last summer, includes a series of *Microsoft Excel* and *Word* for *Windows* macros, thus increasing the speed of information transfer, for example, from

the address book to the letter.

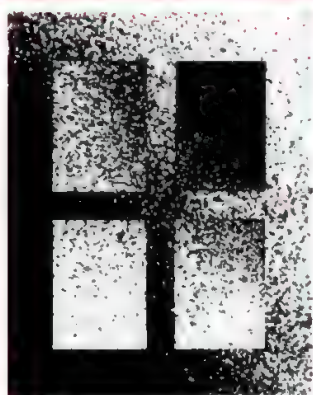
Likewise, IBM's *Current* has markedly extended its Dynamic Data Exchange (DDE) support with the upgrade.

Packrat's focus is the management of time, people, and money. For Version 3.0, the program has evolved its expense facility into a full financial management program. As for graphics, the program now has the ability to store visual representations of a conference room, and can also display GANTT charts. "The advantage of *Microsoft Windows* 3.0 is users can stay active all of the time," said Polaris Software president Jack Leach. Referring to previous versions of *Packrat*, he adds: "In a lot of cases we would be brought down to icon level, but if you ran *PageMaker* or another large program you couldn't run anything else."

In its latest rendition, *Current* has succeeded in doubling its data capacity, and has added the ability to use multiple data directories. The program is ultimately customizable, with the potential to manage everything from employment records to recipes.

It remains to be seen if *Microsoft Windows* 3.0 will prove to have the special features needed to help PC users embrace personal information managers, but these two programs are so customizable, it's likely they'll get a warm reception and find legions of new fans.

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What's more, these products are based on the Microsoft Windows environment, an approach that's not only inherently easy to use, but rapidly becoming the industry standard.

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what you see is what you get. Translated that means the image on-screen looks precisely like the final document.

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Beyond sharing the same overall physical appearance, these applications also share similar commands. So when you've mastered one, you'll have a solid understanding of the other as well.

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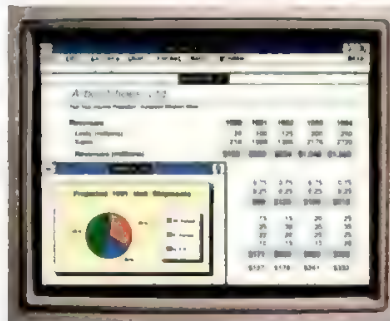
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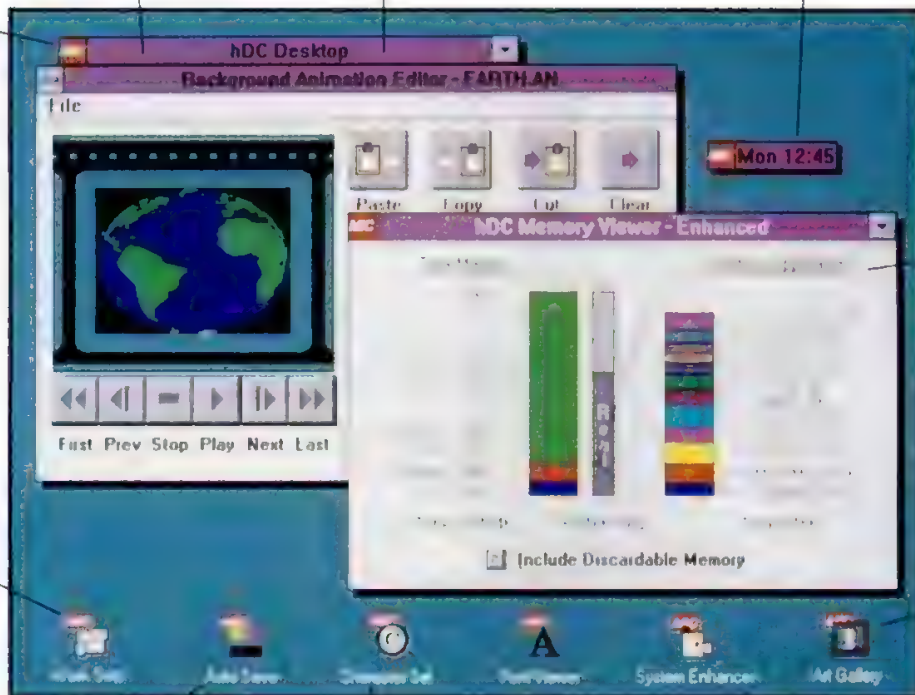
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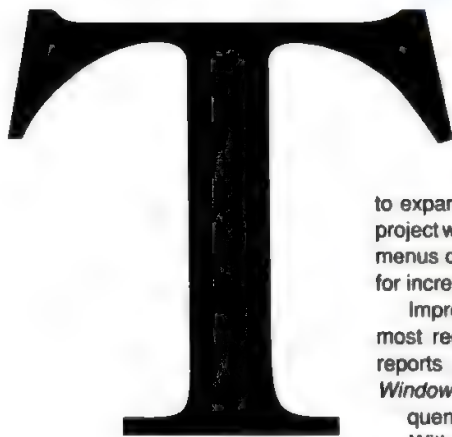
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CONNECTIONS GROW TIGHTER WITH WINDOWS 3.0

Network Ties Smoothed as Data-sharing Among Programs Grows



Rumba will be exciting to anyone who'd like to easily move mainframe data into PC applications.

To the uninitiated, the color and icons in *Windows 3.0* seems like a call to novices. But to a large congregation of *Windows* devotees—primarily in large corporations—the graphical environment is exactly the right place to expand network use and encourage group project work. The extra tools that scroll bars and menus offer make *Windows 3.0* a fertile place for increased use of linked applications.

Improved network capability was one of the most requested improvements for *Windows*, reports Celeste Boyer, product manager for *Windows* systems software, who works frequently with corporate customers.

With *Windows 3.0*, Microsoft addresses the networking issues by providing the expanded memory capability (especially in 80386 systems), basic compatibility to popular major networks (including Novell's *Netware* and Microsoft's *LAN Manager*), and access to net-

ters, the Print Manager capability allows users to view the status of their print job.

For the local area network administrators, Microsoft also eliminated the redundancies in getting a *Windows* package installed in a networked environment. For example, network administrators can now buy one copy of *Windows* (\$149) and additional Microsoft License Paks (\$125), as well as bulk registration.

As networks have mushroomed and grown more difficult to manage, vendors have responded; *FileShare* from Saros Corp. is a prime example.

Using *Windows 3.0* Dynamic Data Exchange (DDE) for data transfer and updates across applications, gives single-user *Windows* applications transparent access to the file storage resources of the network. Saros software resides on both the PC and the file server and runs on most major networking hardware.

Accessing *FileShare* through *Windows* File Manager, allows users to locate, for example, the files on subject "X" they've drafted in the last six months, versions of budgets, and even data from their spreadsheets derived from data from reporting employees, explains Robert Zack at Saros' Bellevue, WA offices.

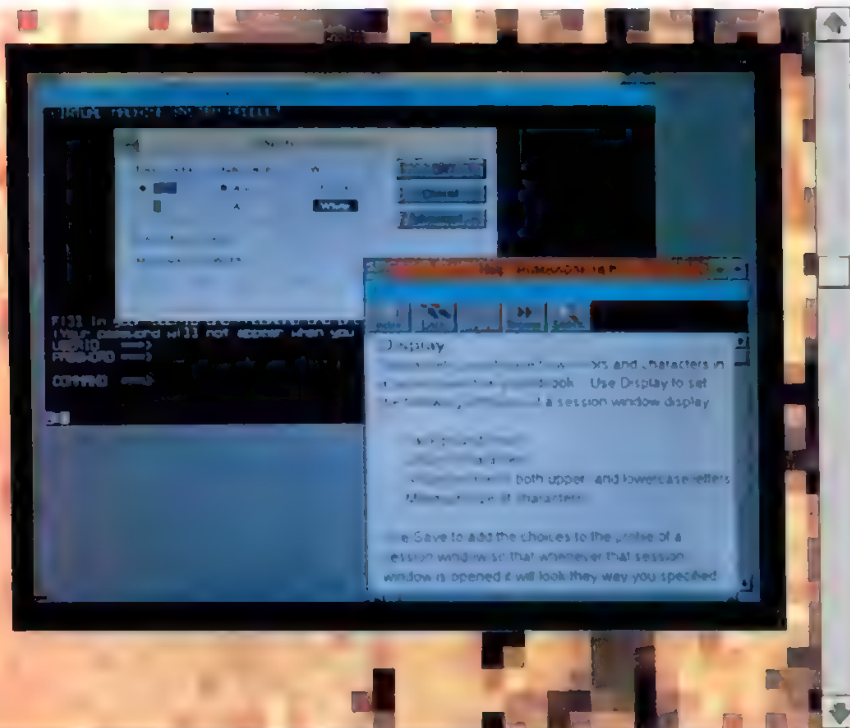
It's that ability to track reiterations of documents that made *FileShare* and *Windows 3.0* ideal for a law office administration system now being installed at the law firm of Perkins, Coie., in Seattle, WA. The U.S. firm with six offices and 360 lawyers had outgrown its Wang VS for word processing and administration and the lawyers were still working on yellow pads.

Perkins, Coie., tested PCs on a LAN running *WordPerfect*, tells Phil Gilbert, head of Gilbert and Associates in Los Angeles, and realized a significant productivity improvement at about the same cost as the Wang system—and in this system, the lawyers were added to the network.

"Perkins, Coie., was able to leverage its investment by getting the professionals to use the system," now made user and mouse friendly, tells Gilbert. "The GUI works particularly well for professionals."

That left nagging document management questions on controlling document versions. Saros *FileShare* and Microsoft's *Word For Windows*, enables both professionals and administrative assistants to access documents throughout the firm, wherever they reside on the system, including the ability to do key word searches. Today on the Saros network, Perkins, Coie., additionally run electronic messaging, and personal time and task management applications along with two or three other *Windows* applications.

In the past developers, and users have ended up patching work-arounds to connect *Windows* PCs to networks. That's now relieved by *Windows 3.0*, tells Doug Stansfield, product manager for the 10Net communications group at Digital Communications Associates (DCA) in



work directories for *Windows* users via the File Manager. *Windows 3.0* users can view where their files are, including those residing either on the network server or in other systems and locations. And in busy offices with several prin-

CONNECTIONS GROW TIGHTER WITH WINDOWS 3.0

continued

Alpharetta, GA, near Atlanta.

"We believe we are the only network operating system that allows server support under Windows," said Stansfield, noting that Windows 3.0 can be the interface to manage the entire network, not just on systems within the workgroup. An added touch on 10Net is that users in a pop-up CHAT program can directly communicate with each other.

3270 AS A CORE APPLICATION

The second major requirement for today's corporate user is the ability to pull data off mainframes, typically IBMs. "For many users 3270 connectivity is a core application as important as word processing or spreadsheets. The information they run their businesses on is centralized information to which they need to have access," said Stephen Kangas, the product manager for Windowlink for IRMA, also at DCA.

The best news for corporate computing managers is that as Windows 3.0 users become autonomous on their PCs, that decreases

the calls they make for help or technical support. "Windows 3.0 lowers their support costs so that MIS managers don't have to spend as much money on the help desk and user support department," observes Kangas. Windows 3.0 makes it more realistic for MIS to mandate they will only support applications which are Windows 3.0 compatible.

The most innovative 3270 connectivity product is probably *Rumba* from Wall Data, Redmond, WA. The ability to "hot link" data from the

The huge variances between how and how fast the mainframe processes data versus the comparatively slower PC creates headaches for developers

IBM mainframe into spreadsheets and other applications is what *Rumba* is all about, describes John Wall, chairman and founder. *Rumba* accesses the large IBM mainframe systems—which are running at speeds much higher and under varying communications technologies—through whatever IBM architecture is in place on the host: VM/CMS, MVS/

TSO, CICS, or IBM Token-Ring local area network (LAN). *Rumba* under Windows 3.0 is \$595 per unit through direct sales.

AUTOMATING REPORTS

Functions such as "record" within *Rumba's* macro-making partner, *QuickStep*, allows users to embed procedures to *Rumba*, so that once the process steps are captured in a macro, they need not be repeated. The quintessential example is the monthly download of financial results; once the keystroke sequence is captured, it doesn't need to be repeated from scratch next month. The function is especially useful, said Wall continuing the example, when each month there are many mainframe reports.

Likewise, the new color and graphical display features of Windows 3.0 opens new vistas for the users who interact with IBM mainframes. What's more, "a lot of people will be seeing our product under (Windows) 3.0 for the first time," continues Wall, referring to the corporate users running 80286 or 80386 systems with under one megabyte of memory. (Although *Rumba* was available under Windows 2.x users found many annoying limitations.)

While it's far more pleasant to rhapsodize about the PC-to-mainframe connectivity dream, more frequently it becomes an MIS developer's nightmare, cautions John Nezius, who's been

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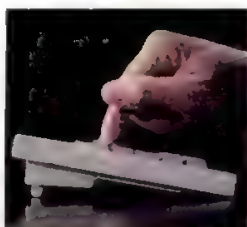
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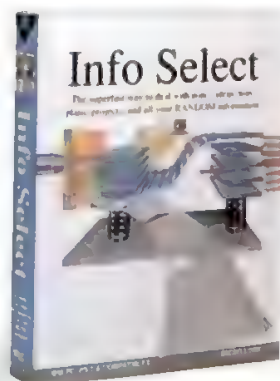
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Windows compatible via compatibility box.

CONNECTIONS GROW TIGHTER WITH WINDOWS 3.0

continued

through the hoop several times at Attachmate, another provider of mainframe connectivity in Bellevue, WA.

The huge variances between how and how fast the mainframe processes data versus the comparatively slower PC creates headaches for developers. Importantly, since 1982, Attachmate has been building this mainframe link and appreciates the need for reliability and robust performance. "Our ability is to put that link there and have it be solid and always work," reports Nezius about the \$425 *EXTRA for Windows*. Attachmate accesses the mainframe under IBM's Token-Ring technology or 3270 terminal emulation. While Attachmate in Bellevue, WA, has other 3270-PC products, *EXTRA for Windows* "is not just a patch program. It is designed from the ground up for the Windows environment."

As businesses and corporations change in the 1990s, developers are responding with new and/or refreshed products, even for the traditional green eyeshade set. Bookkeeping is not commonly associated with icons, color and

jazzy effects, but even that is changing, reports Richard Shaw, president of Absolute Solutions Inc., which has a popular Macintosh-based accounting program. Shaw, in San Diego, CA, is another of the Macintosh developers quickly porting their applications to the PC running Windows 3.0.

Microsoft's *Excel* spreadsheet has been a big plus in showing what GUI can mean to accounting applications, and Shaw's *Computerized Classic Bookkeeping* runs with the power-

As Windows opens up the visual possibilities of the PC, the input and output necessities similarly evolve

ful analysis tool. Now, Windows 3.0 allows major accounting applications to run in two megabytes of memory, a visible savings to Absolute's audience of cost-conscious certified public accountants, Shaw noted, adding "Now the limitations are defined by the hard disk." Absolute's accounting products run from \$395 for small businesses, to \$995 for the CPA.

"Megacorporations are changing and forming larger entities; their requirements are becoming extremely complex and large in na-

ture," describes John Adinolfi at IMRS Inc. in Stamford, CT. But, with all the corporate changes and upheavals around the globe, firms need to know more than ever: is the company making money?

IMRS develops and markets what's called financial consolidation software, PC-based programs which monthly and annually tally the financial results collected from the firm's far-flung locations. This is commonly known as the monthly roll-up when results from each reporting entity are collected (ideally electronically, but often still by paper or facsimile); currencies converted; and results combined in sophisticated data bases. Then, data is tabulated. IMRS' PC product is *Micro Control* from which consolidated data can then be transferred to mainframe systems or on PCs, either *Lotus 1-2-3* or *Microsoft Excel*.

Windows 3.0 opens up much greater memory to handle these large financial consolidations, while the GUI and mouse make it easier to use for non-computer professionals—even including the chief financial officer. The other heightened awareness today is for an attractive look to these financial reports through more accessible printers and plotters.

Financial rollups overseas is a key portion of IMRS' *Micro Control*, and it's in Europe especially where the graphical interface has found

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CONNECTIONS GROW TIGHTER WITH WINDOWS 3.0

continued

eager support, reports Adinolfi at the Stamford firm. Perhaps it's that they're already aware of the disadvantages of multiple languages and currencies as the 1990s push toward a common Europe. Adds Adinolfi, who's firm has offices in Milan and London, and seven distributors worldwide, "Our experience has been that international companies are moving much more progressively to graphical environments than those in the U.S."

As *Windows* opens up the visual possibilities of the PC, the input and output necessities similarly evolve. Improved color printers and high resolution monitors are expected to grow in popularity, along with the scanner for inputting graphics images and text. Each scanner includes proprietary imaging software, and a plurality of these programs are *Windows* based. If something is merely scanned, however, it may not be enough: Just scanning an image in is like taking a Polaroid picture. An optical character recognition (OCR) system is required in order for the scanned text to be edited by a word processing program.

One such system is produced by the Caere Corporation of Los Gatos, CA. *OmniPage*, a \$1,995 package, includes the *Windows*-based software along with a Motorola 68020 coprocessor card to handle the additional graphical load.

Because scanning is memory intensive with a single page occupying 1.2MB of RAM, Larry Miller at Caere enthusiastically expects *Windows* 3.0 to generate interest in scanners and OCR. Further, with DDE scanners can trade immediate information with graphic, spread-

As businesses and corporations change in the 1990s, developers are responding with new and/or refreshed products even for the traditional green eyeshade set

sheet and desktop publishing programs. The *OmniPage*/coprocessor board combination is designed for 80286 machines, the 80386 is served by an \$895 software-only package. Miller admits some difficulty in bringing the 386 product to market, as both *OmniPage* and *Windows* 80386 demand control of the chip's pro-

ected mode abilities. Miller expects the complete *OmniPage* 386 for shipment this fall with users buying the real mode product receiving a free upgrade.

The ability to send visually sophisticated *Windows* documents through FAX machines offers another exciting output option. *Faxit for Windows* (\$199, Alien Computing, Palmdale, CA) is essentially a printer driver that ties into the Print command of any *Windows* application. By routing this command through a phone list, *Faxit* sends the active document over the phone wires in a bitmapped form.

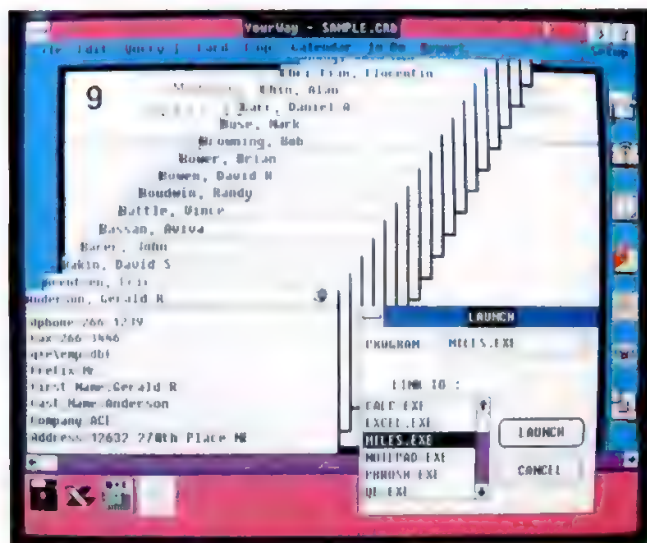
Alien managing director Philip Hopkins promises support for Intel's Connection Coprocessor FAX board, but said he hoped to add drivers for boards from Datacopy, Lightspeed and Relisys. "When *Windows* switches the machine into protected mode hardware access is restricted to protected mode software," he explains. "So we have to write separate drivers for each board we want to support." *Windows FAX*, with increased access, will allow more complex documents to travel over phone lines.

Corporate users especially may find it worthwhile to live with *Faxit*'s limitations: After all, a facsimile created in *Word for Windows* that includes graphics will be far more effective than one originating from a character-based system—and it should be less work.

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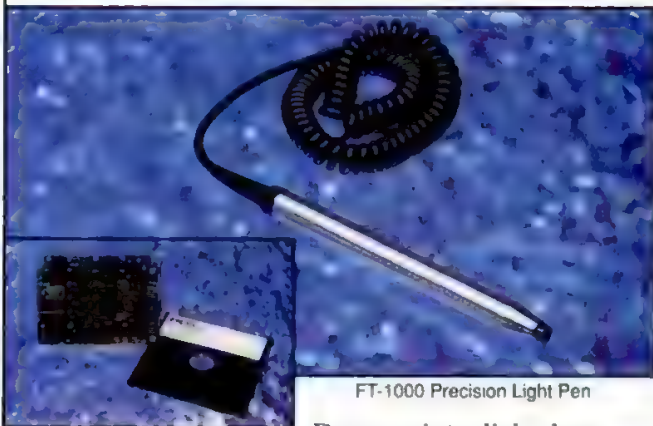
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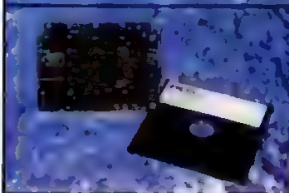
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SOLITAIRE BUILDS MOUSE SKILLS AND PREVENTS CHEATING

The Familiar Pastime Gets a New Lease on Life

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Solitaire is like the time-honored version played with a deck of cards, with one exception: this one doesn't let you cheat.

o number-crunching and report-writing chores get you down in the middle of the day? Do you long for a quick bit of refreshment that won't lead you out of the office?

Microsoft has a quick diversion that you can enjoy without even leaving the *Windows* environment.

Microsoft Windows 3.0 includes an electronic version of one of the most popular games in history. *Windows Solitaire* follows the same rules as the popular card game that has kept many a bored soul busy. *Windows Solitaire*, on the other hand, is addictive fun that may lead you to look for ways to free up your schedule in order to find time for a few rounds. In other words, it's the perfect game for people who don't really like complicated or obscure computer games. It's fast-moving; experienced users and quick studies can play a hand in two

for new PC users—especially those who've always worked on keyboards, for example, in high-production word processing.

Of course, *Solitaire* also demonstrates *Windows*' graphical acumen: The sharp, high-definition images are as clear as those of any deck of cards. The object is to build four ascending Ace-to-King stacks, of the respective suits.

Players draw cards from the deck, or from up to seven piles situated below these stacks. These piles are built in descending sequential order, with alternate color suits. When all exposed cards are placed in available slots, you draw a new card from the top of the deck. A King moves into any of the seven open positions and Aces are set aside to begin each suit's pile.

The first improvement over the real-life version of *Solitaire* is the automatic shuffling, which is the most time consuming part of the game. This is balanced by an inability to cheat. The time-honored tradition of breaking *Solitaire*'s rules to reveal hidden cards doesn't work here. *Windows Solitaire* doesn't allow any illegal moves, but you'll be less tempted: a freshly shuffled deck can be laid down with a couple of mouse clicks.

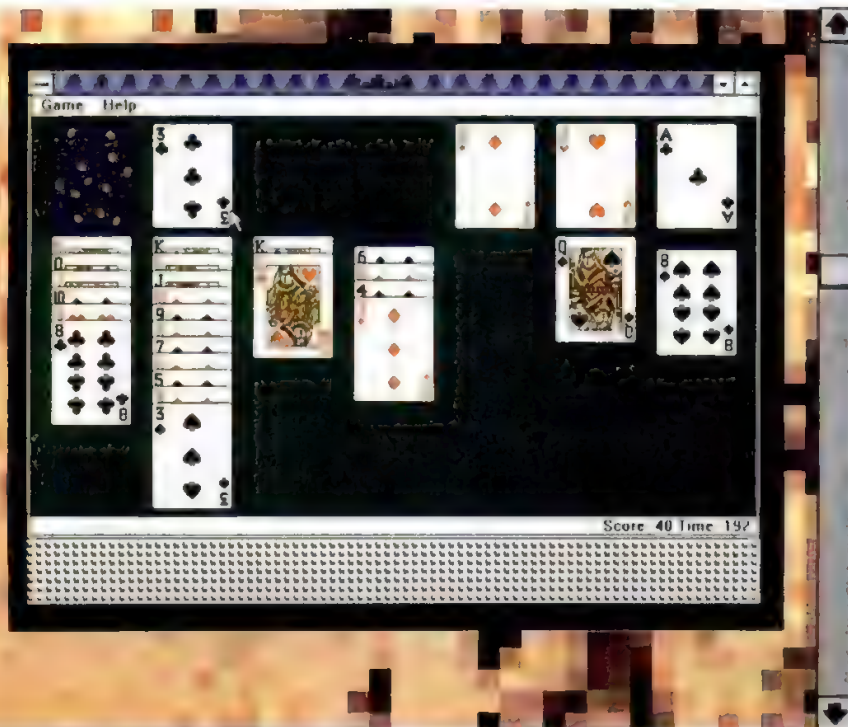
Moving cards requires mouse motion, and playing *Windows Solitaire* rapidly is a good way to develop mouse control techniques. If a card belongs on a stack, such as a visible "Two of Spades" fitting on an exposed Ace, double-clicking on the Deuce sends it to the appropriate place.

Solitaire features a few interesting visual tricks: The 12 colorful decks include patterns, seashells, fish and roses, and four of these are animated. Bats fly around a bleak castle; an Ace slips out of a sleeve; and a yellow sun above a beach scene suddenly winks and sticks out its tongue.

But the best effect is saved for last. When a user succeeds in stacking the entire deck into the four suits, the deck bursts into a choreographed dance of cards. Starting with the four Kings and working its way down to the Aces, *Solitaire* fans all of the cards out in a hypnotic pattern.

Just as *Reversi* helped introduce countless users to earlier versions of *Windows*, *Solitaire* will be the sort of intriguing program that encourage novices to click on menu options and explore different areas of the screen. It will also help introduce them to the concept of application folders, since *Windows* installs itself with three distinct folder icons that are marked "Applications," "Accessories" and "Games." It won't take much prodding to get new users to explore the "Games" folder.

Solitaire is fun, fast and, importantly for non-game enthusiasts, winnable. From a somewhat anemic history of *Windows* games, *Solitaire* opens up an illustrious future. And, confesses one enthusiast: "It's one of the best games I've ever played—right next to *PacMan* and *Tetris*."



minutes, or so.

The developers report Microsoft also had an ulterior motive for including the game. Learning to play *Windows Solitaire* is a fun way to learn the mouse, which may be unfamiliar and difficult

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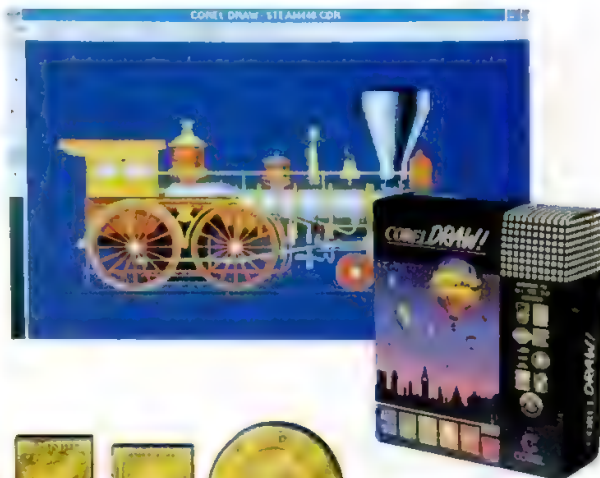
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by
Winn L. Rosch

Lab Notes

Whatever its real or imagined merits, IBM's Micro Channel architecture is by design an all-or-nothing affair. With an eye toward the billions that users and companies alike have already invested in boards built to fit the classic AT bus, the industry has recently responded by introducing an *inclusive* bus standard of its own, known as EISA (Expanded Industry Standard Architecture). Developed under the leadership of the so-called "Gang of Nine" (AST Research, Compaq Computer Corp., Epson, Hewlett-Packard Co., NEC, Olivetti, Tandy, Wyse, and Zenith Data Systems), EISA is an attempt to provide for the needs of the 32-bit world of the 1990s while retaining full compatibility with the equipment designed and built for the classic 16-bit AT bus.

In last issue's Lab Notes I covered many of EISA's basics: additional data and memory lines, design of a two-tier connector that would permit old boards to be plugged into EISA computers but prevent new EISA boards from being inserted into older machines, and the addition of new, faster data transfer modes to keep the bus from being the bottleneck. In this concluding part of our semitechnical EISA overview, I'll discuss some of the specifics involved in implementing this comprehensive and very versatile standard.

UNDAMMING DMA

If any one aspect of classic AT bus systems has stood in need of improvement, it is the Direct Memory Access system. Despite using a special DMA controller chip to handle movement of memory blocks—thus lightening the load on the microprocessor—PCs and ATs have failed to perform up to DMA's promise. So painfully slowly does DMA work in these systems that in the AT, DMA itself was abandoned for hard disk transfers.

Specifically, DMA transfers on an AT ordinarily take place at the agonizingly slow rate of 1MB per second. Although by using the three 16-bit DMA channels in the AT a speed of 2MB per second is theoretic-

A Further Look at The New EISA Standard For the PC Bus

■ Sophisticated DMA, bus mastering, and easy setup procedures help provide a real challenge to IBM's dominance in PC architecture.

cally possible, DOS is limited to 8-bit transfers, which cuts the theoretical rate in half.

The new DMA timings and techniques in the EISA design embody some of its most creative aspects. In addition to supporting AT-compatible DMA transfers, EISA adds three new types, termed Types A, B, and C (the last is also known as Burst DMA). All three types can make 8-, 16-, or 32-bit transfers. Moreover, multiple transfers can be chained to send the same bytes to different locations. Under EISA, it's possible to attain a 33MB-per-second transfer rate when using 32-bit transfers in burst mode.

The default DMA timing, set for old-style AT-compatible 8-bit transfers, is the slowest EISA mode. The EISA specification envisions the other modes being implemented through software drivers. With the proper drivers, most classic-bus expansion boards will be able to take advantage of Type A transfers, and a few will also be capable of double-speed Type B transfers. New EISA boards are required to use either Type C or 32-bit transfers of any type.

Each successive DMA type brings an improvement in data transfer rate. For a given data path width, Type A transfers are

about 30 percent faster than AT-style DMA. Type B transfers double the AT speed. Type C transfers are more than four times faster than AT transfers.

Most of the speed increases from one type to the next are the results of specifying different data transfer protocols that involve fewer and fewer bus cycles for each DMA move. In the AT environment, for example, each DMA move (8- or 16-bit) requires eight bus cycles. During most of this time nothing is really happening, and thus Type A transfers simply trim two of the wasted bus cycles from each DMA move. Type B transfers impose more stringent conditions by cutting the number of cycles per DMA move to four. Because relatively recent expansion boards can generally operate at higher rates, however, many classic-bus expansion cards can operate at the speed needed for Type B transfers.

Type C DMA transfers compress all the necessary signal manipulations into a single bus cycle, with specific signal transitions occurring at the leading and trailing edges of the bus clock. Only EISA expansion cards are capable of this transfer method, and even they have their limitations. Because the timing is so tight, only the 10 lowest-order bits of the address bus are allowed to change, with the result that Burst Mode DMA transfers on EISA are limited to addresses within a single 1,024-byte page.

In addition to creating new, high-speed transfer modes, the EISA specification also expands the reach of DMA. Addressing limitations restricted DMA transfers in classic-bus systems to the lowest 16MB of

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memory addresses. EISA allows DMA transfers anywhere within a 4GB range of physical memory.

The rate at which data can move during a DMA transfer depends on how many bits are moved at once. All seven EISA DMA channels support up to 32 bits; the channels differ only in priority. The higher-numbered channels (5, 6, and 7) are serviced more often when an EISA system is heavily loaded.

BUS STOPS

Data and address lines aren't the only things in short supply in classic bus systems. System interrupts dwindle to a precious few when even a modest number of expansion boards are plugged in. For optimum performance, nearly every device connected to the input/output channel—from hard disks to serial ports to video controllers—demands at least one interrupt.

The AT system design added seven more interrupts when the original PC complement of eight proved inadequate. EISA could have followed the same course and enhanced new systems with new interrupt channels, but that strategy becomes overly complex and expensive as the number of interrupts increases.

The more moderate approach taken by EISA is to share interrupts between peripherals. With sharing, the 15 existing interrupts could potentially serve the needs of even a fully expanded EISA system.

Maintaining classic-bus compatibility while implementing interrupt sharing creates a technological nightmare, however. The principal reason for this is that the AT bus is based on *edge-triggered* interrupts, in which an interrupt is signaled by a quick pulse. System hardware is left to track where the pulses originated. Should two peripherals attempt to share the same edge-triggered interrupt at or near the same time, however, their pulses may get mixed up. Moreover, noise can disrupt an edge-triggered interrupt system.

The alternative is a system of *level-sensitive* interrupts, in which a continuous logic-level voltage indicates the presence of an interrupt throughout its duration. This system is inherently less susceptible to noise and confusion. But using level-triggered interrupts in the PC environment presents problems.

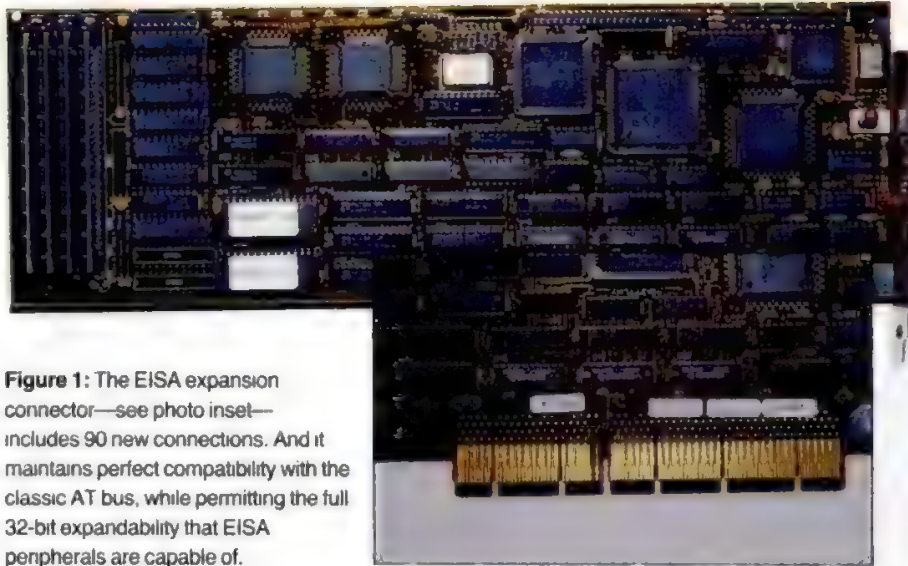


Figure 1: The EISA expansion connector—see photo inset—includes 90 new connections. And it maintains perfect compatibility with the classic AT bus, while permitting the full 32-bit expandability that EISA peripherals are capable of.

Getting level-sensitive interrupts to work with software that uses edge-triggered interrupts is one difficulty. Maintaining compatibility with existing edge-triggered boards is another, particularly since the two kinds of interrupt won't work together on a given interrupt control line.

The EISA approach is to make each in-

ing the hardware involved in the conflict. Fortunately, the EISA design minimizes this danger by specifying the inclusion of a current-limiting resistor in the interrupt lines of level-sensitive EISA boards. Nevertheless, EISA supports interrupt sharing only on EISA boards. Existing classic-bus expansion cards cannot share interrupts with each other or EISA cards.

**An EISA system
conserves interrupt
channels by having
its peripherals share
those available.**

terrupt individually programmable between edge-triggered and level-sensitive operation. Old boards can use the edge-triggered interrupts they prefer, one board per interrupt. New EISA expansion boards can share the other interrupts, which will be programmed as level sensitive.

The final obstacle to successfully implementing this system is that level-sensitive interrupts require a different kind of hardware from that used by the edge-triggered variety. Because of this difference, plugging in a board designed to use an edge-triggered interrupt effectively blocks the use of that interrupt by level-sensitive boards.

Indeed, this technological difference even carries with it the potential of damag-

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That all new microcomputer bus designs, including EISA, involve *bus mastering* is hardly surprising. The underlying and obvious idea is that you can get more performance both from your system's microprocessor and from its expansion bus if you impose a division of labor such that the one doesn't waste its time with the work of the other.

In the traditional PC and AT designs the microprocessor is responsible for maintaining the bus—for moving data around from one peripheral to another. The amount of data the microprocessor can move becomes the data transfer limit of the bus. Worse, as that limit is approached, a substantial fraction of the microprocessor's thinking time becomes devoted to bus work, so the system slows down.

The bus master design breaks the direct connection between the microprocessor and the expansion bus. Instead, some expansion boards are allowed to take direct control of the bus and handle all aspects of their own data transfers. While such an expansion board is loading bytes into memory, for instance, the system's microprocessor could be doing other things, such as carving through a tough calculation in its memory cache.

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Any expansion board that can take control of the expansion bus in this way is called a *bus master*, because it can take control of its own domain. Boards that obey the commands of the masters are called *slaves*. In addition to the host microprocessor, the EISA standard allows up to six bus masters to rule their own fiefdoms within a given computer.

Delegating autonomous control to a number of individual elements creates its own problems, of course, such as deciding which one should get control and when. Bus masters clamoring for control are not unlike kids wanting a turn at the Nintendo set—they want it and want it now!

So to prevent confusion and anarchy, EISA imposes a control scheme—called arbitration—on access to the bus. The control element is the *Integrated System Peripheral* (ISP) chip. (One might have expected it to be called the EISA Bus Controller, instead.) The ISP chip determines which system function gets control of the expansion bus, arbitrating disputes according to EISA's rules for determining priority.

Control rotates through three classes: memory refreshing, DMA transfers, and a combination of the microprocessor and bus masters. In every control cycle, each one of these elements receives control in turn. If, however, several DMA channels request bus control, only one gets it per control cycle. In effect, control is like a menu in an old-fashioned Chinese restaurant—in each arbitration cycle, the system selects one from column A, memory refreshing; one from column B, DMA; and one from column C, the bus masters or the microprocessor.

Which of the seven EISA DMA channels gets control rotates through the circle of those needing it, until all DMA channels are served. As illustrated in Figure 2, this rotation is based on a pair of cycles that creates a kind of wheel-within-a-wheel arrangement. While the three high-priority DMA channels correspond to the 16-bit channels in an AT system, the EISA specification permits them to use any transfer width. These three channels go through one rotation set and the four lower-priority channels go through another. The result is arranged so that one low-priority channel gets control for each complete cycle of the three high-priority channels.

The microprocessor and bus masters form another wheel-within-a-wheel arrangement. Each time the microprocessor/bus master column is selected, either the microprocessor or a bus master gets control, whichever was *not* selected on the last cycle. In other words, the microprocessor is served half the time, the bus masters the other half. Another cycle selects which of the various bus masters gets served when it's a bus master's turn.

As a consequence of this arrangement, memory refreshing is assigned the highest priority in an EISA system. Every arbitration cycle includes memory refresh. That's as it should be, of course, because without

memory refreshing, the system would crash. DMA transfers are the next-highest priority; one active DMA channel can get attention every cycle. The microprocessor has the next-highest level of priority, getting control at least every other cycle.

At best, any given bus master can only match the priority level of the microprocessor. If several bus masters are active, each gets control only after a delay of many arbitration cycles. Considering the complexity of this arbitration hierarchy, the hardware that brings it to life is surprisingly simple. Only two slot-specific signals are needed for each expansion board. The controlling logic is all contained inside

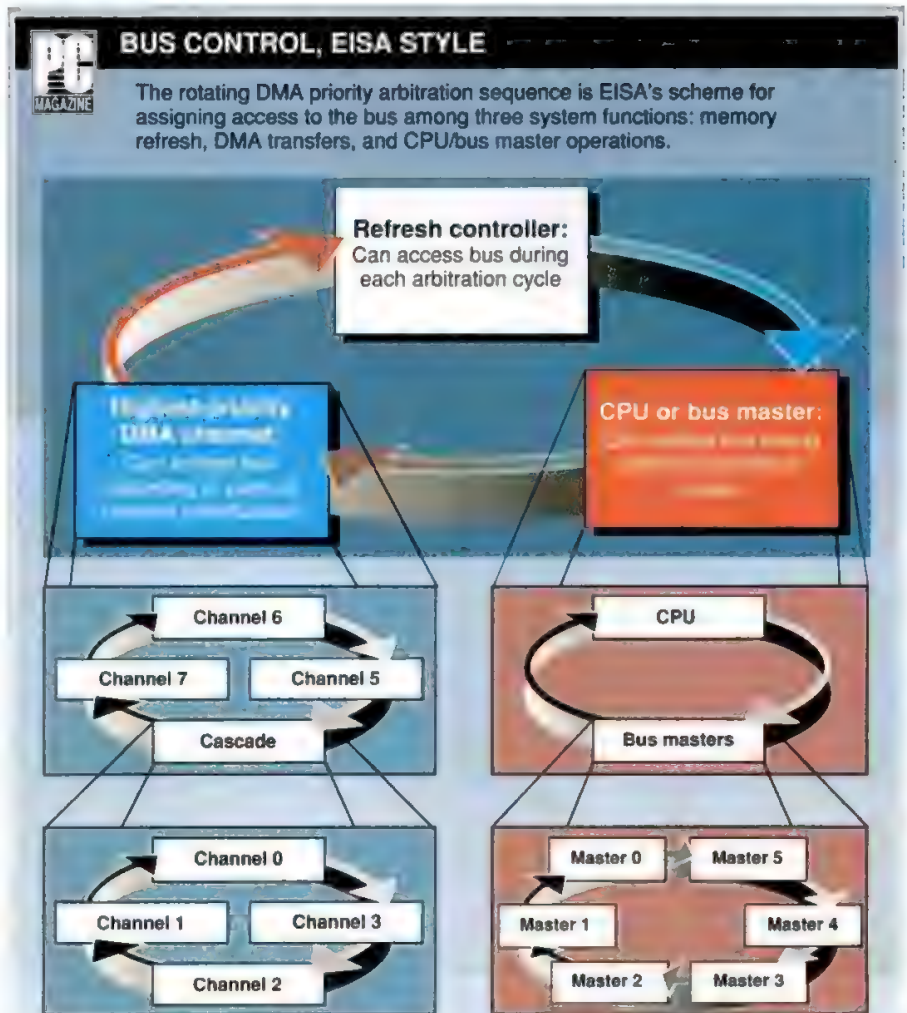


Figure 2: The wheels-within-wheels arbitration system used by EISA's ISP chip sets the priority each peripheral device is assigned and assures no system functions—memory refresh, DMA transfers, and CPU/bus master operations—are denied access to the bus. The main "wheel" assures that memory is always refreshed once per arbitration cycle (hence the preeminent position of the Refresh Controller in the diagram). One second-level subsidiary wheel assigns two levels of priority to DMA channels (Channels 5, 6, and 7 may be serviced up to three times more often than channels 0 through 3, which share a wheel one level further down). The other second-level wheel splits priority among the microprocessor and bus masters (boards that relieve the load on the CPU by taking control of the expansion bus). Priority among bus masters rotates in a third-level wheel.

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the ISP chip, so the designers of expansion boards need not worry about complex decision-making circuitry.

When a bus master board wants bus access, it simply asserts its Memory Request line (abbreviated MREQ_x in EISA nomenclature, where *x* is the slot number). The ISP informs the bus master that it can take control of the bus by asserting the Memory Acknowledge (MAK_x) signal associated with the slot in which the bus master is located.

The EISA standard also allows a form of bus mastering to be achieved using the AT bus alone. Such cards use the DMA signals to control the bus, with the DMA Request (DRQ) line indicating a need to use the bus. Permission is sent back to the board on the associated DMA Acknowledge line (DAK).

Because these classic bus masters don't have access to all the EISA timing signals, however, they have a potential for over-staying their welcome. They could get so involved in a transfer that they failed to relinquish control to the one function that absolutely *must* have it—memory refresh. Consequently, the EISA design requires these boards to carry built-in timing circuits that limit the duration of their bus access.

LEAVE THE DRIVING TO US

What with addressing and interrupt considerations, four DMA types, different data transfer modes, and the rest of the EISA variables, it would seem that the minimum requirement for setting up all the technical wizardry that EISA's engineers have conjured up into a system would be a magic wand.

Even without the EISA innovations, setting up a classic-bus expansion board has generally been an exercise in frustration, requiring careful matching of DIP switch and jumper settings with the board's needs, the interrupts available, and the memory installed in the host system. Make one mistake—which is almost assured, given the deplorable state of most documentation—and the host system is likely not even to boot, let alone diagnose the problem. Fortunately, EISA incorporates several strategies to alleviate these setup problems.

The EISA design automatically prevents conflicts in the assignment of some

system resources. In addition, it incorporates a software-mediated setup procedure that finds, flags, and even corrects conflicts to the extent of automatically configuring the system! If that's not enough versatility, EISA also allows old-fashioned switch-and-jumper board configuration as well.

One particularly inspired aspect of EISA's design automatically eliminates conflicts among input/output port assign-

ments. In classic-bus computers, expansion boards were allowed to use any port in the range 100h to 3FFh for their needs. You were left with the job of assigning ports from within whatever range the board maker had selected to use. And you were left with the responsibility of detecting and resolving conflicting port assignments among your various boards.

By contrast, the EISA design assigns a unique range of ports to each expansion



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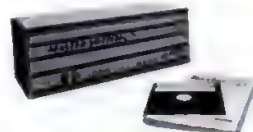
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slot. Boards are still confined to a limited range of three-digit hexadecimal addresses, but each expansion slot adds an extra digit to distinguish the ports used by its associated board from those belonging to the other slots. This scheme makes it physically impossible for two boards to try to use the same I/O port addresses.

Each board can also be individually addressed in order to ferret out information stored in common locations. By selectively activating the AEN_x bus line for each slot, the host EISA system can query individual boards, isolate them, or simply identify them.

Each make and model of EISA expansion board is assigned a unique EISA Product Identifier, which is stored on the board at input/output port addresses 0C80h to 0C83h. The first 2 bytes store, in compressed form, a three-letter abbreviation that identifies the board manufacturer. (The specific characters ISA are reserved to indicate generic classic-bus boards.) The next byte encodes a two-digit product number, and the final byte encodes a two-digit revision number. The manufacturer's abbreviation is assigned by BCPR Services, the organization that distributes the EISA specification. Manufacturers create their own product and revision numbers. System boards are assigned identification numbers using a similar scheme.

Supplementing this slot- and card-identification arrangement is an automated setup system. Through a standardized setup program, you can allocate the resources of your EISA system or let the system automatically set itself up.

This system brings together several diverse elements. Setup information is maintained in a hardware extension to the CMOS configuration memory used by AT-class computers. Additional battery-backed-up CMOS memory is assigned to the job of remembering the essential parameters of the board installed in each expansion slot.

To load this information into memory, each EISA system manufacturer provides a setup program, either on-disk or in ROM. This program interacts with each product that requires setup through Configuration Files, making use of disk-based database records that hold setup information in a standardized format set by the EISA specification. The setup program

reads the disk-based data to customize itself for the setup needs of each specific product installed in the computer host.

The product identification numbers are used as a key. Stored in CMOS memory, they are used to look up Configuration Files each time the system is switched on. The system centralizes the nonvolatile memory needed to store the setup information for each board, eliminating the expense of incorporating such memory into each expansion product.

Even the interface of the setup program has been standardized across EISA machines, so if you can set one up, you know

**A unique addressing
scheme in the EISA
design makes it
impossible for two
boards to use the
same I/O port
addresses.**

how to configure them all. If you don't, mastering the procedure is easy—you need only to pull down menus to choose the options you want.

END OF THE TOUR

Admittedly, this has been a whirlwind tour of EISA. We've been able to draw attention only to EISA's major points of interest, and careful readers will realize that there is a great deal more to be explored. Overall, EISA represents a very well thought out, tightly integrated system. While other extensions to the classic bus had been developed before EISA (the 32-bit expansion slots of Intel's OEM system boards is a notable case in point), none had won wide industry support.

With the powerful Gang of Nine behind it, however, EISA automatically has that support. Moreover, EISA gives the world a completely defined standard, a powerful one, and one that can effectively serve as a replacement for the classic AT bus. ■

Winn L. Rosch is a contributing editor of PC Magazine.

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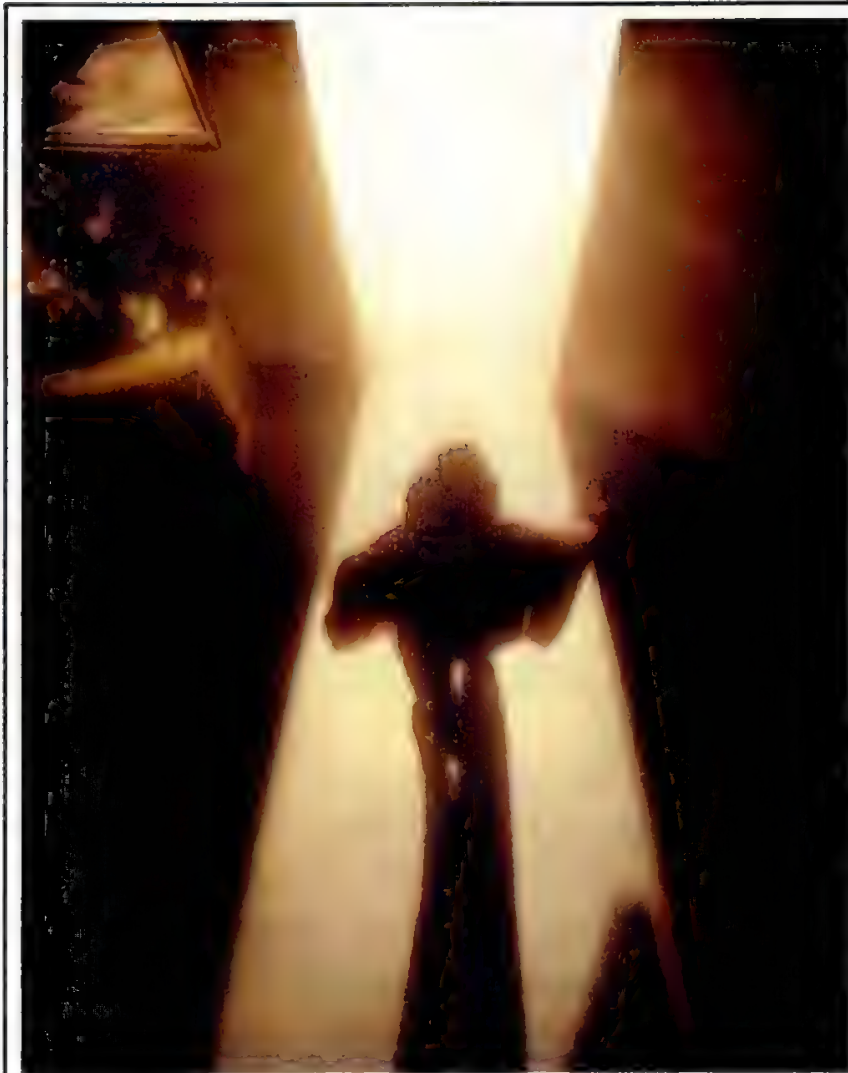
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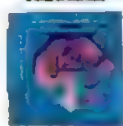
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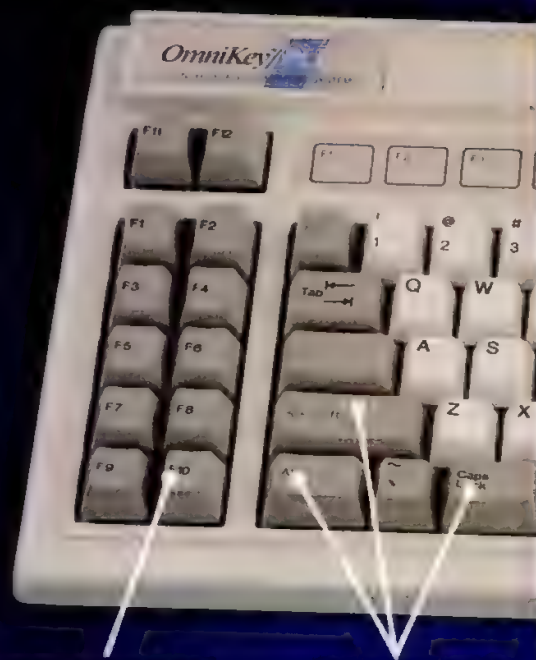
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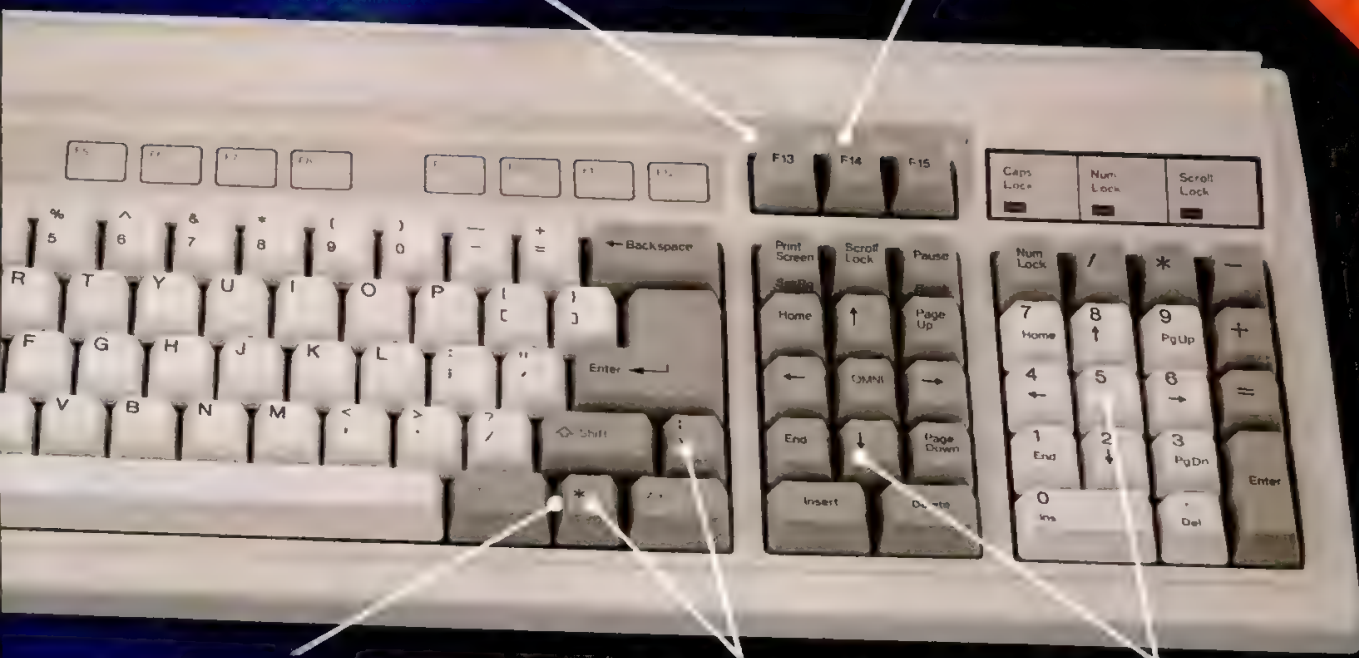
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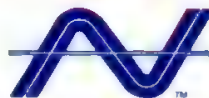
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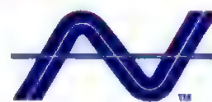
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by
Michael J. Mefford

Utilities

Most of us add directories and subdirectories as the need arises, giving little thought to the tangled mass of branches that eventually results. We know that an efficient filing system requires a well-designed disk directory structure, but we'll tidy up the organization "later."

Reorganizing an existing directory structure using DOS commands is no easy matter, however. It involves making new directories, copying files, deleting old files and finally removing old directories. It's a formidable, laborious process, full of potential for disastrous mistakes. Indeed, if the disk is nearly full, there may not even be room to copy or move the files around. So we put off reorganization and put up with a filing system that only Radar or Klinger could understand.

In contrast to DOS procedures, this issue's utility, PRUNE.COM, makes directory management not only easy, but pleasurable. PRUNE presents your directories in a logical graphic tree configuration and then lets you move, copy, delete, and rename directories or entire branches of your directory tree, using an intuitive point-and-shoot interface. You can also lop off entire branches and graft them onto a different branch or even a different tree on another drive. And integrated with PRUNE are functions to call up two of my previous file management utilities, DR and DIR-MATCH, with which you can examine and update the contents of your directories before manipulation.

The sidebar "PRUNE by Modem" gives you instructions for downloading PRUNE.COM from PC MagNet. From the same source you can also download PRUNE.BAS and PRUNE.ASM, printed here. To create an executable from the source code requires using a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM PRUNE;  
LINK PRUNE;  
EXE2BIN PRUNE PRUNE.COM
```

Trim the Branches of Your Directory Trees With PRUNE.COM

■ What lopping shears and grafting tools do to uncontrolled growth in your garden, PRUNE can accomplish for your hard disk.

PRUNE SYNTAX

The full syntax for PRUNE is simply

```
PRUNE [d:] [d:]
```

Entering PRUNE without either of the optional drive arguments (*d:*) will display the directory tree of the current drive in two identical side-by-side windows, as shown in Figure 1. To display a drive other than the default, just enter that drive as the

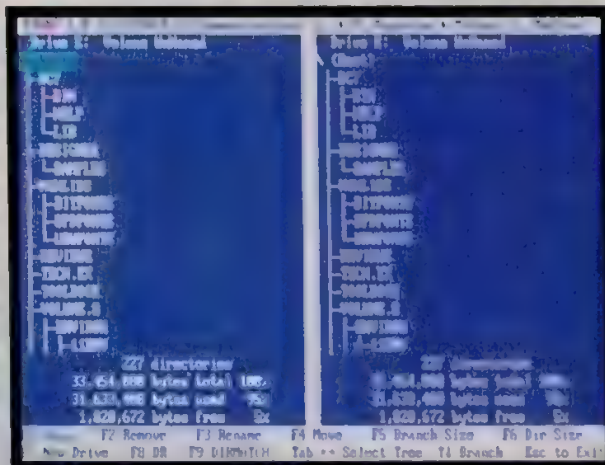
first optional drive. If you want to manipulate two drives simultaneously, specify both; the first will appear in the left window and the second in the right window. For example, if the current drive is C:, entering

```
PRUNE A: D:
```

will display the A: drive tree in the left window and that of D: in the right. You can also change the displayed directories once PRUNE is running.

When PRUNE first comes up, the *active* tree is in the left window. The active tree is displayed in white, with the directory selection bar initially on the \ (Root). The inactive tree on the right is shown in light gray. You can toggle back and forth between the two windows, making each the active window alternately, by using the

Figure 1: If no initial drive letter is supplied, PRUNE displays the directory tree of the current drive both in its active (left) and its inactive (right) windows. The program lets you copy, move, remove, rename, or graft directory branches either within the directory tree of its own drive or that of any other drive on the system.



Utilities

Left and Right Arrow keys or Tab key. .

The remaining keypad navigation keys (Up Arrow, Down Arrow, PgUp, PgDn, Home, and End) move the highlight bar through the directory tree in the active window. You can exit from PRUNE at any time by pressing Esc.

Each level of the tree is displayed in alphanumeric order. You can quickly select a directory by pressing the alphanumeric key for the first letter of the directory name. Successive presses of the same key will take you forward through all the directories that begin with that letter. There will be a short beep if no match is found.

Any hidden directories will display the letter H to the right of the directory name. PRUNE lets you operate on (and even remove) hidden directories just as if they were normal directories.

PRUNING YOUR DIRECTORIES

The function keys control the operations you can perform on your directories with PRUNE. You simply select a directory with the highlight bar and then press the desired function. It's important to realize, however, that Copying, Moving, or Removing a directory affects not only the highlighted directory, but *all of that directory's dependent subdirectories*, as well. This is easy to remember if you think of the directory structure as a tree. You can't stand out on a limb of a branch and cut off that branch without precipitating yourself (and it) to the ground.

Thus, for example, if you have a disk tree that looks like

```
C: \ (Root)
  |
  +-- TEMP
      |
      +-- DOC
```

and you remove the TEMP directory and its files, you will also remove TEMP's subdirectory DOC and its files. To suppose otherwise would require being able to leave the DOC directory magically suspended in air without support. PRUNE will not let you copy, move, or remove the root directory.

What follows is a summary of the function-key command operations:

■ **F1 (Copy):** To copy a directory, its files, and any subdirectories it may have, highlight the directory and then press F1.

A right arrow symbol will appear to the left of the selected directory and PRUNE will ask you to highlight the destination directory for the branch.

Use the navigation keys to highlight the desired new parent directory for the branch. The destination can be a directory in the current active window *or*, if you hit Tab (or the Left or Right Arrow key, as ap-

propriate), the destination can be a directory in the inactive window—even if that directory tree is on a different drive.

Press Enter when the destination directory is highlighted. PRUNE will then ask you to press Y to confirm and start the copying process. Press N, Esc, or any other key to cancel. PRUNE will not start the copy process if there is not enough disk space to finish.

PRUNE will not copy a directory if the destination directory has an existing file or subdirectory with the same name.

■ **F2 (Remove):** Press F2 to remove the highlighted directory and any subdirectories of that branch, together with all their files. Pruning old dead directories is necessary to make room for new growth. Since removing the wrong branch through error can be such a serious matter, however, PRUNE warns you with a beep and a message. You are then required to confirm by pressing Y and Enter before the pruning process begins.

Use F2 with care. If you're not sure what a branch contains, use the DR utility (described below) to inspect its contents before pruning. If for some reason you do inadvertently lop off a valuable branch, stop your session with PRUNE *immediately* and recover your files with one of the file-rescue utilities, such as *The Norton Utilities* or *Mace Utilities*.

■ **F3 (Rename):** After pressing F3, you can type in a new name for the highlighted directory. A directory name can have up to 8 characters and a 3-character extension. Extensions, however, are not usually applied to directories.

■ **F4 (Move):** Moving directories around to rearrange and rationalize your filing system is the most powerful function of PRUNE. The procedure for moving a directory is the same as that for using the Copy command (F1) described above. First, highlight the directory you wish to move; second, press F4; and third, highlight the new parent for the directory. The only difference between Copy and Move is that the old branch is removed from its previous parent.

When moving a directory from one drive to another, PRUNE automatically performs two steps. First the directory is copied to the new location and then the old directory is removed. You must remember that all the dependent subdirectories and files will come along with the moved directory.

Moving a directory around within the same drive is a completely different pro-

UTILITIES UPGRADES

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. The only way to obtain the modified versions is to download them from PC MagNet. Here is a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ANSI.COM, Version 1.3

CARDFILE.COM, Version 1.1

CHKFRAG.EXE, Version 1.2 (now works with volumes greater than 32MB)

DIRMATCH.COM, Version 2.0

EMS40.SYS, Version 1.1 (fixes a problem that EMS 4.0 had with *Lotus 1-2-3*)

LITES.COM, Version 1.1

LOG.COM, Version 1.1

MENU.COM, Version 1.1

RN.COM, Version 2.0 (now works under DOS 4.x).

SLICE.COM, Version 1.3

SNIPPER.COM, Version 1.2

ZCOPY.COM, Version 1.2

For a complete list of all the programs available from the PC MagNet Utilities Database, download UDCAT.ARC.

A downloadable index to *PC Magazine's* product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine Reviews Index* for January 1988 to December 1989. This easy-to-use database is a subset of the *Computer Library Periodicals Database*, which is available on CD-ROM and on PC MagNet. It requires the search files in PCSRCH.EXE.

PCSRCH.EXE is a self-extracting archive containing the software used to retrieve citations from the *PC Magazine Reviews Index*. Please read the information file PCM.INF before you download any of these files. ■

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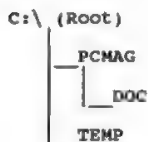
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Utilities

cess. No files are actually moved: only the pointer to the parent of the directory is changed. You might think of this simply as rearranging the lines that link the tree diagram together without moving the names.

Although a complicated procedure, moving directories around on a single drive involves very little disk activity. It is thus very, very fast. You can move hundreds of files in a directory to a new parent in the blink of an eye. Further, you can move directories around even on a full disk. For a more in-depth explanation of how this works, see the "Dot and Dot-Dot" section below.

You cannot move a directory to its parent nor to a lower limb on its branch. Thus, if you have a tree



you cannot move PCMAG to the root directory, its parent, because it is already there. Nor can you move PCMAG to DOC, since that doesn't make any logical sense. You could, however, move PCMAG to TEMP.

■ **F5 (Branch Size):** This command returns the number of *cluster* bytes used by the highlighted directory, its files, and any dependent subdirectories. Cluster bytes represent the space actually used on-disk by the branch. This space is invariably larger than just the sum of the file sizes.

Disk space is allocated in chunks called clusters. A typical cluster size is 2,048 bytes. Any file with a size between 1 byte and 2,048 bytes will use up the same amount of disk space, that is, 2,048 bytes. PRUNE uses the branch size to determine whether there is room to copy or move a branch to a different drive.

On a crowded disk, checking a branch size will quickly help you decide which branch to prune in order to get some elbow room. You should use branch size in conjunction with the current free bytes on the disk displayed at the bottom of the directory listing. Incidentally, the total bytes, bytes used, and bytes free shown in the active window are also counted in terms of cluster bytes; this is the same procedure used by CHKDSK.

■ **F6 (Dir Size):** The directory size report is very similar to the branch size report, except that it applies only to the highlighted directory and does not include any of its subdirectories. If a branch doesn't have any subdirectories, then branch size and directory size reports will be the same.

■ **F7 (New Drive):** Pressing F7 allows you to load a new tree and display it in the active window. Simply enter the new drive letter; no colon is necessary.

PRUNE, a directory manager, comes interlinked to two other PC utilities, DR and DIRMATCH, which can examine and update the contents of your directories before manipulation.

■ **F8 (DR):** DR is a popular file manager utility I wrote some time ago (it appeared in our August 1987 issue) that, among other things, lets you call up and read the files in a directory. By pressing F8 you can shell out from PRUNE and run DR. DR.COM must be in a directory included in the DOS PATH statement. If you have a floppy-only system, you will also need to have a copy of COMMAND.COM, along with DR, in the boot floppy drive.

Inspecting a directory with DR is an excellent way to confirm that a directory you are about to remove does not contain any important files. The directory loaded into DR will be the currently highlighted directory in PRUNE. If DR is not found on your path, you will get a brief DOS "Bad Command" message, after which PRUNE will reread the disk and pop back up. If you don't have DR, you can download it from PC MagNet. The "Customizing PRUNE" sidebar provides instructions on changing the interlinked program from DR to one that—hard as it is for me to believe!—may be more to your liking.

■ **F9 (DIRMATCH):** DIRMATCH, one

of my more-recent file management utilities (*PC Magazine*, September 26, 1989), displays the files in two directories side by side and lets you update the target directory with files from the source directory. When you press F9, you will be prompted to highlight the first (source) directory for DIRMATCH to display. Press Enter to select. Do the same for the second (target) directory. The two directories can be on different drives if PRUNE's windows are of different drives. As with DR, DIRMATCH must be found in the DOS PATH. Again, if you don't already have it, you can download DIRMATCH from PC MagNet.

PRUNE supports various popular video modes, such as the EGA 43 line and VGA 50 line. If you find PRUNE's color scheme difficult to read or just prefer different colors, see the sidebar "Customizing PRUNE."

CAVEATS

Unless you have remarkable patience, I suggest that you not copy or move directories across two different floppy disk drives. Depending, of course, on the size of the move or copy, the process can be lengthy. And it's worse if you have only one physical floppy disk drive: the swapping of floppies as each file is copied or moved will drive you crazy. If you need to do so, copy the branch temporarily to a hard disk and then move it to the desired floppy.

If you use multitasking software, such as *DESQview*, *386MAX*, or *Microsoft Windows/386*, don't switch to another task while PRUNE is working. Giving control to another application that does disk I/O while PRUNE is in the middle of modifying the directory structure could cause fatal disk problems.

Note also that PRUNE may be incompatible with some virus-protection programs. The reason for this is that PRUNE uses direct sector disk access, which can cause protection programs to scream in anguish.

THE PROGRAMMERS' CORNER

After my *BATCHMAN* was published (January 30, 1990), I made a discovery that bears also on PRUNE's operation, which I'd like to share with the programmers among our readers. *BATCHMAN*'s Qformat function uses the DOS disk direct sector access interrupts 25h and 26h. Qformat reads a disk's directory and FAT sectors and writes them back as zeros. This ef-

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Utilities

fectively frees all of the disk space—the equivalent of a quick format.

I received reports from a few people via PC MagNet that after a Qformat, a DIR of the disk would report that the data was still there, when actually it was not. This strange “remembering” no doubt has to do with either DOS buffers or disk cache software.

I found that issuing an INT 21, function 0Dh (Disk Reset) instruction just before and after an INT 25h or 26h effectively jogged DOS’s memory. Although the description of function 0Dh, “Write file buffers that have been modified to the disk” does not exactly fit the “remembering” problem, it does the trick. I would strongly suggest you adopt this approach if

you have reason to use interrupts 25h or 26h. If you have experienced this “remembering” problem with Qformat, you can get an updated BATCHMAN from PC MagNet.

Since PRUNE also uses sector I/O interrupts 25h and 26h, I’ve incorporated what I learned about these interrupts in Qformat by issuing the Disk Reset calls before and after each sector read or write.

DOT AND DOT-DOT

One other interesting aspect of the PRUNE program involves dealing with the . and .. directories (dot and dot-dot). These directory entries are DOS’s way of keeping track of a disk drive’s directory-tree linkages. Dot and dot-dot actually occupy space on-disk just as does any other directory record entry, and they are always the first two entries in a directory. The exception is the root directory, which does not

have dot and dot-dot entries.

The dot directory entry is a pointer to the owner of the directory, that is, to itself. The dot-dot entry is a pointer to the directory’s parent. You can use dot and dot-dot with DOS commands such as CHDIR just as you can use any other directory name. For example, you can change to the current directory’s parent by entering

```
CD ..
```

CD, of course, is the abbreviation for CHDIR. Although I don’t have room here to go into specific examples, changing to the parent directory can be a very useful command. It’s also legal to enter

```
CD .
```

This will “change” to the current directory, which does nothing and is useless, but

CUSTOMIZING PRUNE

by Michael Mefford

Some systems, especially laptops, don’t display color contrasts very well. If you find PRUNE hard to read, you can force it to use black-and-white attributes by entering the command MODE BW80 before running the program. The best way to do this is from a batch file containing the lines

```
MODE BW80
PRUNE %1 %2
```

If you have a color system and PRUNE is using black-and-white attributes, chances are that some other application has changed the video mode. To encourage PRUNE to use color, issue

the DOS command

```
MODE CO80
```

before running the program.

MODIFYING PRUNE.COM

The following instructions will enable you to customize the colors used by PRUNE. It will also enable you to change the program run by pressing F7. Start by making a backup copy of PRUNE.COM and then enter

```
DEBUG PRUNE.COM
```

You are now ready to modify the utility. If at any time you make a mistake,

simply abort the editing process by entering Q. The last two commands that you enter after entering any modifications are

```
W
Q
```

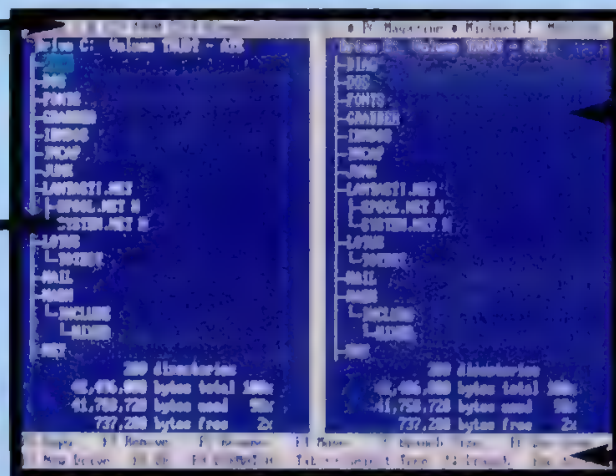
for Write to disk and to Quit DEBUG.

COLOR SCHEME

The screen shown below is annotated in order to show the default color descriptions and their values. To change the color, enter the corresponding DEBUG instruction by replacing xx with an alternative hex color value from the following list:

Menu color
Blue on light gray 71h
E 17B xx

Active tree
White on blue 1Fh
E 17E xx



Inactive tree
Light gray on blue 17h
E 17C xx

Menu bar
Blue on light gray 71h
E 17D xx

Utilities

you won't get a DOS error message for doing so.

THE DOUBLE-DOT

The *real* interest in the dot-dot directory entries comes from the way PRUNE manipulates them to move a directory, its files, and subdirectories to another parent without actually physically moving any of them on the disk. This results in very fast moves! Note, however, that the technique I'll describe here will work only for moves within the same logical disk partition. Moving directories and files from one disk to another requires physically moving the data.

You'll find it useful to follow along in the Directory Move diagram shown in Fig-

ure 2 as I describe the changes made to the dot-dot entry to move the directory UTIL from the root directory to the PCMAG directory. The cluster number to the right of the name of each directory is an index to the location of that directory on-disk. Cluster numbers are converted to actual sector numbers when the disk data is accessed.

The contents of each directory cluster are in the form of directory entry records. Each directory record contains 32 bytes, which provide fields for the name, extension, attribute, creation time and date, starting cluster number, and file size in bytes. PRUNE cares only about the name, attribute, and starting cluster fields, so to keep things simple, only these fields are shown in the diagram. Note that the 10h in the attribute field indicates that the entry is a directory; a zero is used to indicate a file.

In the Before section of the diagram, the UTIL directory entry is in the root di-

rectory cluster. As shown in the UTIL directory starting cluster field, the third cluster is where the UTIL directory is stored. If you look at the UTIL directory, you'll see that the first entry is dot with a 3 in its starting cluster field. The 3rd cluster is the UTIL directory; the dot entry, therefore, points to itself, the owner of the directory. The dot-dot starting cluster number, 0, points to the parent directory, the root directory.

To move the UTIL directory from the root directory to the PCMAG directory, three things must occur. The first is that the UTIL directory entry must be physically moved from the root cluster to an empty entry in the PCMAG directory cluster. The second step is to delete the UTIL entry in the root. This is done by changing the first letter of UTIL to E5h, DOS's delete code. The E5h is what you are asked to change back to U when using file-recovery software like *The Norton Utilities*.

The last step involves the dot-dot entry of the UTIL directory. To reflect the disowning of UTIL by the root and the adoption of UTIL by PCMAG, the starting cluster number of the dot-dot parent pointer must be changed from 0, the root, to 2, PCMAG. Once these three changes are written to disk, the UTIL directory and its subdirectory DOC and the file PRUNE.COM will all belong to PCMAG.

IT'S TRICKY

Of course, implementing all this isn't quite as easy as it may sound. It involves things such as reading the disk boot sector, which has information needed to figure out the locations of the root directory, the FAT, and the first data cluster on-disk. Reading the sectors and writing them back are done with DOS interrupts 25h and 26h, respectively; this must be done with extreme care so as not to corrupt the disk. Note also that the INT 25h and 26h instructions have two different formats, depending on whether or not the disk partition is greater than 32MB.

While I don't have space here to go into all its programming details, I do want to mention one precaution PRUNE has to take in the moving process. As I just indicated, the only physical move PRUNE has to make is to shift the directory entry to the new parent's directory. To do this requires that there be a free record to receive it. A free record will have as its first character the E5h delete character or a zero (which indicates that it has never been used).

Like files, directories are allocated

Dark colors

0 Black
1 Blue
2 Green
3 Cyan
4 Red
5 Magenta
6 Brown
7 Light gray

Light colors

8 Dark gray
9 Light blue
A Light green
B Light cyan
C Orange
D Violet
E Yellow
F White

It is also possible to change the color of DR. The default is light gray on blue (17h). To change it, use the instruction E 17F xx.

The background color number is entered for the first x and the foreground color for the second x. Do not use a light color for the background, or the display will blink.

For example, in order to change the bar color from blue on cyan (31) to blue on light gray (71) you would enter the following:

E 57A 71

PRUNE turns on the border, and some monitors can't handle that. In order to disable the border, enter the following instruction:

E 185 1

Replace the 1 with a 0 to reenable the border.

REPROGRAMMING F7

Pressing F7 in PRUNE will run the DR.COM utility if it is found on your DOS PATH. To substitute a different utility for DR, enter

E 192 ``12345678``

where 12345678 is the eight-character name of the utility you want to use instead. Make sure to *include* the quotes shown above, but do *not* add either the period or the extension (.COM or .EXE) of the alternative utility. Append spaces if the utility name is less than eight characters. Thus, for example, if you have DIRMAGIC, a popular subscription premium from *PC Magazine's* sister publication, *PC Computing*, you would enter

E 192 ``DIRMAGIC``

The DR next to the F7 in the menu will not change, but DIRMAGIC will be executed all the same. Remember that the new utility has to be in the DOS PATH. To change the F7 utility back to DR, enter

E 192 ``DR``

Finish the DEBUG session with

W
Q


```

; PRUNE - PC Magazine - Michael J. Nefford
;
; Directory tree pruning and grafting utility.
;

```

```

_TEXT SEGMENT PUBLIC 'CODE'
ASSUME CS:TEXT,DS:TEXT,ES:TEXT,SS:TEXT
ORG 100H
JMP MAIN

; DATA AREA
;
SIGNATURE DB CR,SPACE,SPACE,SPACE,CR,LF
COPYRIGHT DB "PRUNE 1.0 (c) 1990 Siff Communications Co. ",CR,LF
PROGRAMMER DB "PC Magazine ",BOX," Michael J. Nefford",LF
CRLF DB CR,LF

SYNTAX DB "Syntax: PRUNE [d:] [d:]",CR,LF,LF
DB "$",CTRL_Z

TAB EQU 9
CR EQU 13
LF EQU 10
CTRL_Z EQU 26
SPACE EQU 32
BOX EQU 254
VERT_LINE EQU 179
FP EQU 12
SHIFT_KEYS EQU 3
LITTLE_ARROW EQU 26
ESC_SCAN EQU 1
Y_SCAN EQU 15H
N_SCAN EQU 31H
NOTE EQU 1046 ; C

COLOR_ATTRIBS STRUC
B DB 71H ;Blue on lt. gray
W DB 17H ;Lt. gray on blue
C DB 31H ;Blue on cyan
I DB 17H ;White on blue
D DB 17H ;Lt. gray on blue
COLOR_ATTRIBS ENDS

COLOR COLOR_ATTRIBS <>
COLOR_ATTR COLOR_ATTRIBS <>
MONO_ATTR COLOR_ATTRIBS <70H, 07H, 70H, 07H, 07H>

BORDER_FLAG EQU 0 ; -1 to disable.

COMSPEC DB "COMSPEC="
PARAMETER1 DB 30, "/C DR", 25 DUP (SPACE), CR
PARAMETER2 DB 100, "/C DIRMATCH "
ARGUMENTS DB 112 DUP (SPACE), CR

ENVIRONMENT DW ?
COM_LINE_PTR DW ?, ?
STACK_SEG EQU ?
STACK_PTR DW ?

BREAK DB ?
DEFAULT_DRIVE DB 7, "-", CR

CRT_MODE EQU 49H
CRT_COLS EQU 40H
CRT_ROWS EQU 84H
COLUMNS EQU ?
CRT_WIDTH EQU ?
CRT_START EQU ?
STATUS_REG DW 3000H
VIDEO_SEG DW 00000H
ROWS DB 24
LISTING_LEN EQU ?

ROOT DB "\ (Root)"
ROOT_LEN EQU $ - ROOT
ROOT_DIR DB "\",0
DOT_DOT DB "..",0
VOL_DRIVE DB 7, "\ "
STAR_DOT_STAR DB "..",0
TEMP DB "#####",0
E5 DB 025H

UNNAMED DB "Unnamed "
VOLUME_LEN EQU $ - UNNAMED
DRIVE_SPEC EQU " Drive "
DRIVE_LETTER EQU 7, " Volume ",0
VOLUME_NAME EQU VOLUME1,VOLUME2
VOLUME1 EQU 11 DUP (?),0
VOLUME2 EQU 11 DUP (?),0
SECTOR_RECORDS EQU ?
ROOT_SECTOR DW ?
ROOT_SECTORS DW ?
CLUST_RECORDS DW ?
LAST_CLUSTER DW ?
LAST_ENTRY EQU ?
TREE_LEVEL EQU ?

DIRS EQU ?
DIR_COUNT DW 7,7
LISTING_TOP EQU 0,0
BAR_LINE DW 0,0
ACTIVE_TREE DW 0
TREE_COLOR DB ?

MAX_ENTRIES EQU 1000
BUFFER_SEG LABEL WORD
FAT_SEG EQU ?
TREE_DATA_SEG DW 7,7
TREE_SEG EQU 7,7
CLUSTER_SEG EQU ?
OLD_PARENT EQU ?
NEW_PARENT DW ?

BIG_DISK_FLAG DB ?
DATA_SECTOR EQU ?

SOURCE_INDEX EQU ?
SOURCE_POINTER LABEL DWORD

```

```

SOURCE_LINE DW ?
MARK_SEG DW ?
SOURCE_BAR DW ?
DEST_POINTER LABEL DWORD
DEST_LINE DW ?
DEST_SEG DW ?

PACKET LABEL BYTE
STARTING_SECTOR DW 7,7
NUMBER_OF_SECTORS DW ?
TRANSFER_ADDRESS DW 7,7

BPS LABEL BYTE
BPS_BytesPerSector DW ?
BPS_SectorsPerCluster DB ?
BPS_ReservedSectors DW ?
BPS_NumberOfFats DB ?
BPS_RootEntries DW ?
BPS_TotalSectors DW ?
BPS_MediaDescriptor DB ?
BPS_SectorsPerFat DW ?
BPS_LENGTH EQU $ - BPS

FAT_TYPE DB ?
FAT_16_BIT EQU 0
FAT_12_BIT EQU 1

TREE_DRIVE DB 7,7,7
DEFAULT_PATH DW OFFSET DEFAULT_DIR1, OFFSET DEFAULT_DIR2

FREE_CLUSTERS DW 7,7
TOTAL_CLUSTERS DW 7,7
BYTES_CLUSTERS DW 7,7
DIRECTORIES DB "directories",0
BYTES DB "bytes",0
TOTAL DB "total",0
PERCENT_100 DB "100%",0
USED DB "used",0
FREE DB "free",0

CLUSTER_CNT DW ?
TOTAL_FILES DW ?
ENTRY_CNT DW ?
BRANCH_FLAG DB ?
REREAD_FLAG DB 0

BRANCH_NUM DW ?

DTA EQU 00H
MATCHING STRUC
RESERVED DB 21 DUP (?)
ATTRIBUTE DB ?
FILE_TIME DW ?
FILE_DATE DW ?
SIZE_LOW DW ?
SIZE_HIGH DW ?
FILE_NAME DB 13 DUP (?)
MATCHING ENDS

DIR_ENTRY STRUC
DIR_NAME DB 8 DUP (?)
DIR_EXT DB 3 DUP (?)
DIR_ATTR DB ?
DIR_RESERVED DB 10 DUP (?)
DIR_TIME DW ?
DIR_DATE DW ?
DIR_CLUSTER DW ?
DIR_SIZE DD ?
DIR_ENTRY ENDS

SOURCE_RECORD DB SIZE DIR_ENTRY DUP (?)
DIR_LEN DW ?

TREE_DATA STRUC
LEVEL DB ?
ENTRY DW ?
PARENT DW ?
DIRECTORY DB 11 DUP (?)
CLUSTER DW ?
ATTRIB DW ?
TREE_DATA ENDS

TREE STRUC
MARK DB ?
NAME DB 30 DUP (?)
TREE_CLUSTER DW ?
BRANCH_NO DW ?
TREE ENDS

M_DISPATCH DB 40H, 50H, 49H, 51H, 47H, 4FH
DB 0FH, 4BH, 4DH
DB 3BH, 3CH, 3DH, 3EH
DB 3FH, 40H, 41H, 42H, 43H
M_LEN EQU $ - M_DISPATCH

DW UP, DOWN, PGUP, PGDN, HOME, END_KEY
TAB_KEY, LEFT, RIGHT
COPY_BRANCH, REMOVE_BRANCH, RENAME_BRANCH, MOVE_BRANCH
SIZE_BRANCH, SIZE_DIR, NEW_DRIVE, DR, DIRMATCH

D_DISPATCH DB 40H, 50H, 49H, 51H, 47H, 4FH
DB 0FH, 4BH, 4DH
D_LEN EQU $ - D_DISPATCH

DW UP, DOWN, PGUP, PGDN, HOME, END_KEY
TAB_KEY, LEFT, RIGHT

NOT_ENOUGH DB "Requires 276K free memory!"
INVALID_DRIVE DB "Invalid Drive!"
MESSAGE DB CR,LF,"Reading Directories",CR,LF,"$"

CANT_ROOT DB "Can't prune, copy or rename root directory.",0
ILLOGICAL_MSG DB "Illogical to graft to this directory.",0
DUPLICATE_MSG DB "Directory name already exists.",0
SUBDIR_MSG DB "Subdirectory creation error; Can't prune.",0
LOGICAL_MSG DB "Logical error; Can't prune.",0
ANYKEY_MSG DB "Press any key to continue.",0
DEST_MSG DB "Highlight destination directory for branch and press Enter",0
WORKING_MSG DB "Pruning in progress...",0

```

PRUNE.ASM: This is the assembly language source code for PRUNE.COM, a utility that simplifies directory management.

PRUNE.ASM

2 of 14

```

REMOVE_MSG LABEL BYTE
DB "WARNING: All files in marked dir AND it's subdirs will be lost. Continue"
YES_NO DB "Y / N"

REMOVE_MSG2 LABEL BYTE
DB "Press Enter to confirm and start directory branch removal. Esc to cancel."
TO_MSG DB " "
DELETE_MSG DB " "

FILES_MSG DB " "
ENTER_MSG DB " "
SIZE_MSG DB " "

DRIVE_MSG DB " "
DRIVE_MSG_LEN EQU 8
DRIVE_ERR DB " "

COPY_MSG DB " "
ROOM_MSG DB " "

RENAME_MSG DB " "
DOS3_MSG DB " "

MSG DB " "
COPYA DB " "
MOVEA DB " "

MENU DB "F1 Copy F2 Remove F3 Rename F4 Move F5 Branch Size "
DB "F6 Dir Size "
DB "F7 New Drive F8 DR F9 DIRMATCH Tab "
DB "27,26," Select Tree "24,25," Branch Esc to Exit",0
;
; CODE AREA
;
MAIN PROC NEAR
;String instructions forward.
MOV AX,1308H ;Get Ctrl-Break state.
INT 21H
MOV BREAK,DL

MOV AH,19H ;Get default drive so can
INT 21H ; restore after we change it.
MOV DEFAULT_DRIVE,AL

MOV BX,(12*128+44+4+6) * (1024/16)
MOV AX,4AH ;Allocate memory.
INT 21H
JNC SETUP_STACK
MOV DX,OFFSET NOT_ENOUGH
JMP ERROR_EXIT ;If not enough, exit.

SETUP_STACK: MOV AX,OFFSET STACK_POINTER ;Set up stack.
MOV SP,AX
AHD
MOV CL,4
SHR AX,CL
MOV CX,DS
AHD
MOV AX,CX
ADD FAT_SEG,AX ;And data segments.
ADD AX,128 * (1024/16)
MOV TREE_DATA_SEG[0],AX
ADD AX,MAX_ENTRIES * SIZE_TREE_DATA / 16 + 1
MOV TREE_DATA_SEG[2],AX
ADD AX,MAX_ENTRIES * SIZE_TREE_DATA / 16 + 1
MOV TREE_SEG[0],AX
ADD AX,MAX_ENTRIES * SIZE_TREE / 16 + 1
MOV TREE_SEG[2],AX
ADD AX,MAX_ENTRIES * SIZE_TREE / 16 + 1
MOV CLOSTER_SEG,AX

PARSE: MOV SI,01H
XOR BP,BP ;Tree index.

NEXT_PARSE: LODSB
CMP AL,CR
JNE SI_WHITE
MOV SI,OFFSET DEFAULT_DRIVE ;Use default drive if no pars.
PUSH [SI]
ADD BYTE PTR [SI], "A"
LODSB
CALL DRIVERLIST
POP WORD PTR DEFAULT_DRIVE
JMP SHORT FIRST_DRIVE

SI_WHITE: CMP AL,SPACE
JNE NEXT_PARSE
CALL DRIVERLIST

FIRST_DRIVE: JNE PARSE_ERROR
STORE_DRIVE: MOV TREE_DRIVE[0],DL
CALL SELECT_DISK
PUSH SI
MOV SI,DEFAULT_PATH[BP] ;Get default path so can
CALL GET_DIR ; restore on exit.
POP SI

INC BP ;Next tree.
INC BP

NEXT_PARSE2: LODSB
CMP AL,CR
JE PARSE_END
CMP AL,spEcE
JNE NEXT_PARSE2
CALL DRIVERLIST
JNE PARSE_ERROR

PARSE_END: MOV TREE_DRIVE[2],DL
CALL SELECT_DISK
MOV SI,DEFAULT_PATH[BP]
CALL GET_DIR

BREAK_OFF: XOR DL,DL ;Turn break off.
MOV AX,1301H
INT 21H

CALL SETUP

;..... Main Loop .....
NEXT_KEY: CALL HIDE_CURSOR
CALL CLEAR_KEY
MOV DI,OFFSET M_DISPATCH

```

```

MOV CX,M_LEN
CALL DISPATCH
JNC NEXT_KEY
JMP SHORT EXIT

;-----
PARSE_ERROR: MOV DX,OFFSET INVALID_DRIVE
ERROR_EXIT: PUSH DX
MOV DX,OFFSET SIGNATURE
CALL PRINT_STRING
POP DX
CALL PRINT_STRING ;Print error message.
MOV AL,1 ;Exit with ERRORLEVEL one.
JMP SHORT TERMINATE

EXIT: MOV DX,R0MS
MOV CX,DX ;Clear last two lines.
DEC CX
XOR CL,CL
MOV DX,BYTE PTR COLUMNS
DEC DL
MOV BX,COLOR.B
MOV AX,600H ; by scrolling active page.
INT 10H

BORDER_FLAG,1
JZ PLACE_CURSOR
XOR BX,BX ;Border back to black.
INT 10H

PLACE_CURSOR: MOV DX,CX
DEC DX
MOV DL,DL
CALL SET_CURSOR ;Restore paths.
XOR BP,BP
CALL RESTORE_DIR
INC BP
CALL RESTORE_DIR
XOR AL,AL ;ERRORLEVEL zero.

TERMINATE: PUSH AX
MOV DX,DEFAULT_DRIVE ;Restore default drive.
MOV AX,SES
INT 21H
MOV DX,BREAK ;Restore Break state.
INT 21H
MOV AH,0DH ;Disk reset to flush buffers.
INT 21H
POP AX
MOV AH,4CH ;Terminate.
INT 21H

MAIN ENDP

;
; SUBROUTINES
;
RENAME_BRANCH: MOV AH,19H
INT 21H
CMP AL,1
JAE CAN_RENAME
MOV SI,OFFSET DOS3_MSG
CALL DISPLAY_ERROR
JMP RENAME_END

CAN_RENAME: MOV AX,SIZE_TREE
MUL MAX_LINES[BP]
MOV BX,SOURCE_LINE,AX
OR AX,AX
JNE DISPLAY_OLD
MOV SI,OFFSET CANT_ROOT
CALL DISPLAY_ERROR
JMP RENAME_END

DISPLAY_OLD: CALL CLEAR_KEY
MOV SI,OFFSET RENAME_MSG
CALL WRITE_STRING
MOV SI,SOURCE_LINE
PUSH SI
MOV DX,TREE_SEG[BP]
CALL GET_NAME
MOV CX,SOURCE_LINE,SI
CALL WRITE_STRING

CALL DOS_CURSOR
POP SI
CALL SELECT_DIR
CMP CX,DS
POP DX
MOV DX,OFFSET DOT_DOT
CALL CHANGE_DIR
MOV DX,R0MS
DEC DX
MOV DL,14
CALL SET_CURSOR
MOV DX,DS
MOV DI,OFFSET ARGUMENTS

NEXT_RENAME: CALL GET_KEY
CMP AL,ESC_SCAN
JNE RENAME_END
CMP AL,CR
JE DO_RENAME
XCHG AL,AX
CMP AL,8
JZ BACKSPACE
CMP AL,SPACE
JNE NEXT_RENAME
JNE NEXT_RENAME
MOV DI,OFFSET ARGUMENTS + 12
JNE NEXT_RENAME

STOSB
CALL JMP
WRITE_TTY
NEXT_RENAME

BACKSPACE: CMP DI,OFFSET ARGUMENTS
JZ NEXT_RENAME
WRITE_TTY
MOV AL,SPACE
CALL WRITE_TTY

```




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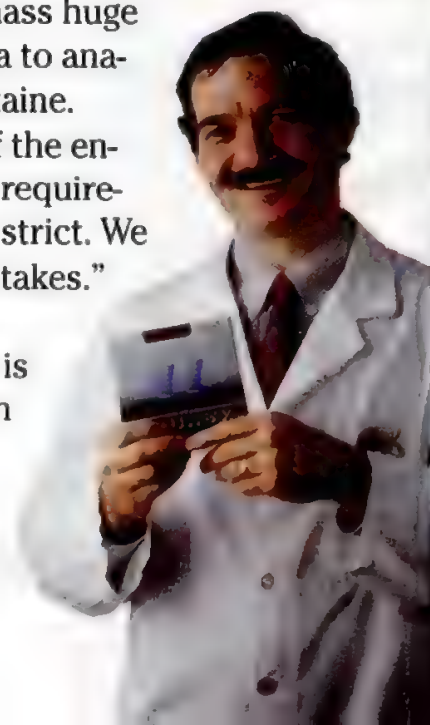
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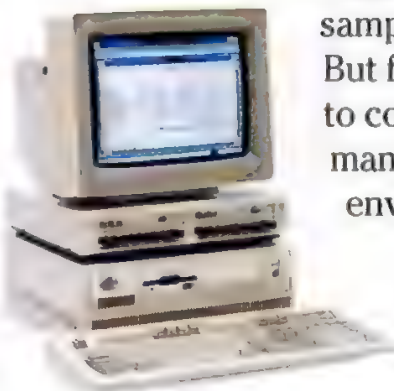
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PRUNE.ASM

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```

MOV AL,8
CALL WRITE_TTY
DEC DI
JMP NEXT_RENAME

DO_RENAME: XOR AL,AL
           STOSB
           CALL DOS_CURSOR
           DI,OFFSET ARGUMENTS
           MOV DX,SOURCE LINE
           MOV DS,TREE_SEG(BP)
           MOV AH,56H
           INT 21H

           PUSH CS
           POP DS
           JNC RENAME_END2
           CALL RENAME_END2
           BEEP
           JMP SHORT RENAME_END

RENAME_END2: MOV REREAD_FLAG,1
             JMP SELECT_UPDATE

RENAME_END: CALL UPDATE_TREE
            CALL DISPLAY_MENU
            RET

;-----;
MOVE_BRANCH: MOV MSG,OFFSET MOVEA
             CALL GET_DEST
             JC MOVE_END
             CMP AL,AH
             JNE DO_COPY
             CALL FAST_MOVE
             JMP SELECT_UPDATE
             ;if yes, only change dot dot
             ; pointers.

DO_COPY: CALL COPY
          JC READ_DISKS
          CALL DELETE
          ; then delete.

READ_DISKS: MOV AX,CS
            MOV DS,AH
            MOV ES,AX
            CMP REREAD_FLAG,1
            JNE MOVE_END
            MOV REREAD_FLAG,0
            CALL READ_DRIVE
            XOR BP,2
            CALL READ_DRIVE

MOVE_END: MOV AX,CS
          MOV DS,AH
          MOV ES,AX
          CALL UPDATE_TREE
          CALL DISPLAY_MENU
          RET

;-----;
COPY_BRANCH: MOV MSG,OFFSET COPYA
            CALL GET_DEST
            JC COPY_END3
            CALL COPY
            JMP SHORT SELECT_UPDATE
            ;Copy the branch.
            ;update the screen.

COPY_END3: CALL UPDATE_TREE
           CALL DISPLAY_MENU
           RET

;-----;
REMOVE_BRANCH: MOV AX,BAR_LINE(BP)
              OR AX,AH
              JNE CAUTION
              MOV SI,OFFSET CANT_ROOT
              CALL DISPLAY_ERROR
              JMP SHORT REMOVE_END

CAUTION: CALL DISPLAY_MARK
          CALL ERASE_MARK
          CALL CLEAR_MENU
          MOV SI,OFFSET REMOVE_MSG
          CALL WRITE_STRING
          CALL BEEP
          CALL CLEAR_KEY
          ;Warning message.

          CALL GET_KEY
          CMP AL,V_SCAN
          JNE REMOVE_END
          CALL CLEAR_MENU
          MOV SI,OFFSET REMOVE_MSG2
          CALL WRITE_STRING
          CALL CLEAR_KEY
          CALL GET_KEY
          CMP AH,CX
          JNE REMOVE_END
          ;Get response.

          MOV DL,TREE_DRIVE(BP)
          CALL SELECT_DISK
          CALL DOS_CURSOR
          CALL DELETE
          ;if yes, log on drive.
          ;Delete the branch.

SELECT_UPDATE: MOV AX,CS
              MOV DS,AH
              MOV ES,AX
              CMP REREAD_FLAG,1
              JNE REMOVE_END
              MOV REREAD_FLAG,0

              MOV BX,BP
              XOR BX,2
              MOV DL,TREE_DRIVE(BH)
              MOV DX,TREE_DRIVE(BP)
              JZ DUP_DELETE
              CALL READ_DRIVE
              JMP SHORT REMOVE_END
              ; if tree drives different,
              ; just update the one.

DUP_DELETE: XOR BP,BP
            CALL READ_DRIVE
            INC BP
            INC BP
            ; Else, if both tree drives same
            ; then just update one and

CALL DUP_TREE
; copy for other.

REMOVE_END: CALL UPDATE_TREE
            CALL DISPLAY_MENU
            RET

;-----;
SIZE_DIR: MOV BRANCH_FLAG,0
          JMP SHORT CALC_CLUST
          ;Just the one directory.

SIZE_BRANCH: MOV BRANCH_FLAG,1
            CALL PUSH DS
            MOV BX,BYTES CLUSTERS(BP)
            MOV AX,SIZE_TREE
            MUL BAR_LINE(BP)
            MOV SI,AX
            OR JZ BRANCH_ERR1
            ;Directory and it's subdirs.
            ;Use current tree's cluster size.

            PUSH SI
            PUSH BX
            CALL DISPLAY_MARK
            CALL ERASE_MARK
            MOV BX,SI
            MOV SI,SI
            ;Root directory?

            CALL DS,TREE_SEG(BP)
            CALL CALC_BRANCH
            MOV SI,OFFSET LOGICAL_MSG
            POP DS
            POP BX
            CALL CLEAR_MENU
            ADD DI,2 * 17
            MOV AL,COLOR.C
            MOV TREE_COLOR,AL
            MOV AX,CLUSTER_CNT
            MOV SI,SI
            MUL SI
            CALL DISP_STATS
            MOV SI,OFFSET CLUSTER_MSG
            CALL WRITE_STRING
            MOV DI,2 * 8
            MOV AX,TOTAL_FILES
            XOR DX,DX
            CALL DISP_STATS
            MOV SI,OFFSET FILES_MSG
            CALL WRITE_STRING
            MOV SI,OFFSET ANYKEY_MSG
            CALL WRITE_STRING
            CALL HIDE_CURSOR
            CALL CLEAR_KEY
            CALL GET_KEY
            CALL UPDATE_TREE
            CALL DISPLAY_MENU
            RET

BRANCH_ERR1: MOV SI,OFFSET SIZE_MSG
            CALL DISPLAY_ERROR
            MOV BX,SI
            RET

;-----;
NEW_DRIVE: CALL DOS_CURSOR
           CALL RESTORE_DIR
           CALL CLEAR_MENU
           MOV SI,OFFSET DRIVE_MSG
           CALL WRITE_STRING
           MOV DS,ROWS
           DEC DX
           MOV DL,DRIVE_MSG_LEN - 1
           CALL SET_CURSOR
           JMP SHORT GET_DRIVE

BAD_DRIVE: CALL BEEP
           CALL GET_KEY
           ;Get new drive letter.

           CMP AL,ESC_SCAN
           JZ DRIVE_RET
           AND AH,5FH
           CMP AH,"A"
           JB BAD_DRIVE
           CMP AH,"Z"
           JA BAD_DRIVE
           ;Capitalize.

           PUSH AX
           MOV SI,OFFSET DEFAULT_DRIVE
           PUSH {SI}
           MOV {SI},AH
           MOV AL,AH
           CALL WRITE_SCREEN
           LODSB
           CALL DRIVEEXIST
           POP WORD PTR DEFAULT_DRIVE
           POP AX
           ;Does drive exist?

           JZ GET_DRIVE2
           MOV SI,OFFSET DRIVE_ERR
           CALL BEEP
           JMP NEW_DRIVE2

GET_DRIVE2: SUB AH,"A"
           MOV WORD PTR TREE_DRIVE(BP),BP
           MOV TREE_DRIVE(BP),AH
           CALL READ_DRIVE
           POP AX
           MOV TREE_DRIVE(BP),AL
           CALL BEEP
           JMP NEW_DRIVE2
           ;Save new drive.
           ;Read it.
           ;if error, prompt again.

DRIVE_DONE: MOV BAR_LINE(BP),0
            MOV LISTING_TOP(BP),0
            CALL CLEAR_DRIVE
            CALL DISPLAY_DRIVE
            ;Display new tree.

DRIVE_RET: CALL DISPLAY_MENU
           RET

```


PRUNE.ASM

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```

;-----;
FIRST_MSG DB "Highlight 1st directory to match and press Enter",8
SECOND_MSG DB "Now highlight 2nd directory and press Enter",8

DIRMATCH: CALL CLEAR_MENU
          MOV SI,OFFSET FIRST_MSG
          CALL WRITE_STRING

NEXT_1ST: MOV DI,OFFSET D_DISPATCH
          MOV CX,D_LEN
          CALL DISPATCH ;Get destination.
          JC DIRMATCH_END ;Abort if Esc.
          CMP AH,CR ;Carriage return if selected.
          JNE NEXT_1ST

          CALL STRELAY_MOVE
          CALL CLEAR_MENU
          MOV SI,OFFSET SECOND_MSG
          CALL WRITE_STRING

          MOV DI,OFFSET ARGUMENTS
          MOV DX,BAR_LINE[BP]
          CALL MAKE_DIR

NEXT_2ND: PUSH DI
          MOV DI,OFFSET D_DISPATCH
          MOV CX,D_LEN
          CALL DISPATCH ;Get destination.
          JC DIRMATCH_END2 ;Abort if Esc.
          CMP AH,CR ;Carriage return if selected.
          JNE NEXT_2ND

          MOV DX,BAR_LINE[BP]
          CALL MAKE_DIR
          MOV AX,OFFSET PARAMETER?
          JMP SHORT EXEC

DIRMATCH_END2: CALL ERASE_MARK
DIRMATCH_END: CALL UPDATE_TREE
              CALL DISPLAY_MENU
              RET

;-----;
; INPUT: DX = Line number
MAKE_DIR: PUSH DS
          MOV AL,TREE_DRIVE[BP]
          ADD AL,"A"
          STOSB
          MOV AL,"."
          STOSB

          MOV AX,SIZE_TREE
          MUL DX
          MOV SI,AX
          MOV DS,TREE_SEG[BP]
          CALL GET_NAME
          KOR CX,CX

NEXT_PATH: CMP SI,1
          JBE NEXT_MAKE4
          PUSH SI
          CALL FIND_PARENT
          INC CX
          JMP NEXT_PATH

NEXT_MAKE4: MOV AL,"\"
          STOSB
          JCKE PATH_END
          POP SI
          LODSB
          OR AL,AL
          JE LOOP_MAKE
          STOSB
          JMP NEXT_MAKE5
          LOOP NEXT_MAKE4

PATH_END: MOV AL,SPACE
          STOSB
          MOV AL,CR
          STOSB
          DEC DI
          POP DS
          RET

;-----;
DR: MOV AX,OFFSET PARAMETER?

;-----;
EXEC: MOV COM_LINE_PTR[0],AX
      MOV COM_LINE_PTR[2],DS

      PUSH DS
      MOV DI,TREE_DRIVE[BP] ;Log on to current tree drive.
      CALL SELECT_DISK
      MOV AX,SIZE_TREE
      MOV DX,BAR_LINE[BP]
      MOV SI,AX
      MOV DS,TREE_SEG[BP]
      CALL SELECT_DIR ;And highlighted directory.
      PUSH CS
      POP DS

      MOV BX,OFFSET STACK_POINTER
      ADD BX,15
      MOV CL,4
      SHR BX,CL
      MOV AX,CS
      ADD BX,AX
      MOV AX,4AH ;Deallocate memory.
      INT 21H

      CALL DOS_CURSOR
      MOV BH,COLOR.D
      CALL CLS? ;White on blue.
      ELI
      MOV STACK_SEG,SS ;Save stack segment and pointer.
      MOV STACK_PTR,SP

      STI
      MOV AX,DS:[7CH] ;Retrieve environment segment.
      MOV ENVIRONMENT,AX ;And put in parameter block.
      MOV DS,AX

      XOR AX,AX ;Zero out pointer.
      MOV SI,AX ;Point to environment offset.
      MOV DI,OFFSET COMSPEC ;Next offset.
      MOV CX,8 ;Find "Comspec=".
      REP CMPSB

      MOV DI,SI
      MOV BX,OFFSET ENVIRONMENT ;What follows is Command.com path.
      MOV AX,4B5EH ;Point to parameter block.
      INT 21H ;Execute.

      CLI
      MOV SP,CS:STACK_PTR ;Restore stack segment and pointer.
      MOV SS,CS:STACK_SEG
      STI
      POP ES ;Restore segment registers.
      POP DS

      MOV DX,88H ;Restore Disk Transfer Address.
      MOV AX,1AH
      INT 21H
      MOV BX,(12*128+64+64*8) * (1024/16)
      MOV AH,4AH ;Reallocate memory.
      INT 21H
      MOV JNC RESTORE_DIAP ;Restore DIAP
      MOV DI,OFFSET NOT_ENOUGH ;Exit if not enough.
      JMP ERROR_EXIT

RESTORE_DISP: CALL SETUP
              RET

;-----;
; INPUT: DS:SI = SOURCE_POINTER -> Source; ES:DI = DEST_POINTER -> Destination
; AL and AH = drive; BX = SOURCE_INDEX; BP = Destination index.
; OUTPUT: CF=1 if failed.
COPY: CALL CK_DUPLICATE ;Does branch name already exist?
      JNE CK_IF_ROOT
      MOV COPY_END2

CK_IF_ROOT: MOV AX,CS
            MOV DS,AX
            MOV ES,AX
            CMP DEST_LINE,0 ;Destination root directory?
            JNE SETUP_DEST
            CALL CREATE_TEMP ;If yes, create and delete
            CALL SETUP_DEST ;temporary directory in root
            CALL FAST_ERROR2 ;to make sure there is room.
            JMP SHORT COPY_END2

SETUP_DEST: MOV DL,TREE_DRIVE[BP] ;Log on destination drive.
            MOV AL,DL
            ADD AL,"A"
            MOV DI,OFFSET DEST_SPEC ;Create destination spec.
            STOSB
            MOV AL,"."
            STOSB
            MOV SI,DI
            CALL GET_DIR

FIND_FILES: MOV BRANCH_FLAG,1 ;Calculate source requirement
            MOV AX,BYTES_CLUSTERS[BP] ;using destination cluster
            PUSH BP ;size.
            PUSH SI
            MOV BP,BX
            MOV BX,AX
            LDS SI,SOURCE_POINTER
            CALL CALC_BRANCH
            POP BX
            POP BP
            JC COPY_END2

            PUSH CS
            POP DS
            MOV AX,FREE_CLUSTERS[BP] ;Is there enough room on
            CMP AX,CLUSTERS_CMT ;target?
            JAE ROOM
            MOV SI,OFFSET ROOM_MSG
            CALL DISPLAY_ERROR
            JMP SHORT COPY_END2

ROOM: MOV DL,TREE_DRIVE[BX] ;Log onto source drive.
      CALL SELECT_DISK
      CALL CONFIRM
      JC COPY_END2
      CALL CLEAR_MENU
      MOV SI,OFFSET COPY_MSG ;Copy message.
      CALL WRITE_STRING
      MOV REREAD_FLAG,1

      PUSH BP
      MOV SI,OFFSET DEST_SPEC ;Find end of destination
      LOOPB ;spec.
      OR AL,AL
      JNE NEXT_SPEC
      DEC SI
      MOV BP,SI

      LDS SI,SOURCE_POINTER ;Log onto source directory.
      CALL SELECT_DIR
      CALL GET_NAME
      MOV DI,SI
      CALL GET_DIRS2 ;Copy branch.
      POP BP

COPY_END2: RET

;-----;
; OUTPUT: CF=1 if unsuccessful.
MAKE_COPY: MOV DX,SI
           CALL CHANGE_DIR ;Next source subdir.
           JC MAKE_COPY_END

```




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PRUNE.ASM

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```

GET DIRS?:  PUSH BP
            PUSH DS
            CALL MAKE_SPEC          ;Make destination spec.
            MOV BP,DI              ;Save end of spec pointer
            DEC BP                  ;as start of next sub
            MOV AX,CS              ;dir appendage.
            MOV DS,AX
            MOV DI,OFFSET DEST_SPEC
            MOV AH,39H
            INT 21H                 ;Create a directory.
            JC MAKE_DONE
            OR CL,CL                ;Is it a hidden directory?
            GET FILE
            MOV CH,2
            MOV AX,4301H
            INT 21H                 ;If yes, make dest hidden also.

```

```

GET FILE:   MOV DI,OFFSET STAR_DOT_STAR
            MOV CH,3
            MOV AH,4EH
            INT 21H                 ;Normal, hidden and read-only.
            JC NEXT_SUB3           ;Find first matching file.
            JNP SHORT MAKE_FILE

```

```

NEXT_FILE?: MOV AH,4FH
            INT 21H                 ;Find next matching file.
            JC NEXT_SUB3

```

```

MAKE FILE:  CALL CREATE            ;Copy the file to destination
            JNC NEXT_FILE2         ;directory.
            JNP SHORT MAKE_DONE

```

```

NEXT SUB3:  POP DS
            ADD SI,SIZE_TREE
            CMP RYTR PTR [SI+1],-- ;Next record.
            JNE DIR_DONE2

```

```

NEXT SUB4:  INC SI
            INC SI
            CALL MAKE_COPY         ;if yes, copy it.
            JC MAKE_DONE2
            DEC SI
            DEC SI
            JNP NEXT_SUB4

```

```

DIR DONE2:  PUSH DS
            PUSH CS
            POP DS
            MOV DI,OFFSET DOT_DOT
            CALL CHANGE_DIR
            POP DS
            MAKE_COPY_END: RET

```

```

MAKE DONE2: POP DS
            MAKE_COPY_END: RET

```

```

;-----
; OUTPUT: CF=1 if failed.

```

```

CREATE:     PUSH SI
            MOV DI,DTA.FILE_NAME
            CALL MAKE_SPEC
            MOV AX,1000H
            INT 21H
            JC CREATE_END
            MOV DI,AX
            ;Read handle.

```

```

            MOV CL,DS:[DTA.ATTRIBUTE] ;File attribute.
            XOR CH,CH
            MOV DI,OFFSET DEST_SPEC
            MOV AH,3CH
            INT 21H
            JC CLOSE_READ
            MOV SI,AX
            ;Write handle.

```

```

            MOV DS,BUFFER_SEG
            XOR DI,DI
            ;Offset zero.
            MOV BX,DI
            MOV CX,9FFFFH
            MOV AH,3FH
            INT 21H
            JC CLOSE_WRITE
            OR AX,AX
            JS CHANGE_DATE

```

```

            MOV CH,AX
            MOV BX,SI
            MOV AH,4EH
            INT 21H
            JC CLOSE_WRITE
            CMP CX,AX
            STC
            JNE CLOSE_WRITE
            INC BX
            JC COPY_READ
            ;Was it a full read?
            ;If yes, there must be more.

```

```

CHANGE DATE: PUSH CS
            POP DS
            MOV BX,SI
            MOV CX,DS:[DTA.FILE TIME]
            MOV DI,DS:[DTA.FILE DATE]
            MOV AX,5701H
            INT 21H
            ;Write handle.
            ;Else, make time/date same
            ;as source.

```

```

CLOSE WRITE: PUSHF
            MOV BX,SI
            MOV AH,3EH
            INT 21H
            POP AX
            JC CLOSE_READ
            JCING AN,AL
            SARF
            ;Save error if any.
            ;Close write file.

```

```

CLOSE READ: PUSHF
            MOV BX,DI
            MOV AH,3EH
            INT 21H
            POPF
            ;Save flags.
            ;Close read file.
            ;Write file status.

```

```

CREATE END: POP SI
            RET

```

```

;-----
; OUTPUT: CL=directory attribute "H" if hidden.

```

```

MAKE_SPEC:  PUSH SI
            MOV SI,DI
            MOV DI,BP
            ;Current spec end.

```

```

            MOV AL,"\"
            CMP BYTE PTR ES:[DI-1],AL ;Add backslash delimiter
            JZ NEXT_MAKE2
            STOSB
            LODSB
            STOSB
            OR AL,AL
            JNE NEXT_MAKE2
            LODSB
            MOV CL,AL
            POP SI
            RET

```

```

;-----
; OUTPUT: DS:SI = SOURCE POINTER -> Source; ES:DI = DEST POINTER -> Destination
;         AL and AH = drive; BX = SOURCE_INDEX; BP = Destination index.
;         CF=1 if abort.

```

```

GET DEST:   MOV AX,BAR_LINE[BP]
            JNZ GET_DEST2
            MOV SI,OFFSET CANT_ROOT
            CALL DISPLAY_ERROR
            JMP SHORT DEST_END

```

```

GET_DEST2:  CALL DISPLAY_MARK
            CALL CLEAR_MENU
            MOV SI,OFFSET DEST_MSG
            CALL WRITE_STRING

```

```

GET_DEST3:  PUSH ACTIVE_TREE

```

```

NEXT_DEST2: MOV DI,OFFSET D_DISPATCH
            MOV CX,D_LEN
            CALL DISPATCH
            JC ABORT_DEST
            CMP AH,CH
            JNE NEXT_DEST2

```

```

            CALL ERASE_MARK
            POP BX
            MOV SOURCE_INDEX,BX
            MOV AX,SIZE_TREE
            MUL BAR_LINE[BP]
            MOV DI,AX
            MOV DEST_LINE,AX
            MOV AN_TREE_SEG[BP]
            MOV ES,AX
            MOV DEST_SEG,AX
            MOV AL,TREE_DRIVE[BX]
            MOV AN_TREE_DRIVE[BP]
            MOV SI,SOURCE_LINE
            MOV DS,TREE_SEG[BX]
            CLC
            RET

```

```

DEST END:   RET
ABORT DEST: CALL ERASE_MARK
            ADD SP,2
            STC
            RET

```

```

;-----

```

```

CONFIRM:    PUSH DS
            CALL HIDE_CURSOR
            CALL CLEAR_MENU
            MOV SI,MSG
            CALL WRITE_STRING

```

```

            PUSH BP
            MOV BP,SOURCE_INDEX
            MOV DI,SOURCE_BAR
            CALL DISPLAY_PATH
            POP BP

```

```

            MOV SI,OFFSET TO MSG
            CALL WRITE_STRING

```

```

            MOV DI,BAR_LINE[BP]
            CALL DISPLAY_PATH
            MOV SI,OFFSET YES_NO
            CALL WRITE_STRING
            CALL CLEAR_KEY
            CALL GET_FY
            CMP AL,Y_SCAN
            CLC
            JZ CONFIRM_END
            STC

```

```

CONFIRM END: PUSHF
            CALL DOS_CURSOR
            POPF
            POP DS
            RET

```

```

;-----

```

```

; INPUT: DI = Bar line.

```

```

DISPLAY PATH: PUSH DI
            MOV DI,OFFSET ARGUMENTS
            CALL MAKE_DIR
            MOV DI,DI
            MOV DI,DI

```

```

            MOV SI,OFFSET ARGUMENTS
            CMP DI,OFFSET ARGUMENTS + 2
            JNE DISPLAY_PATH2
            PUSH BP
            MOV BYTE PTR ARGUMENTS + 2,0
            CALL WRITE_STRING
            MOV SI,OFFSET DOT_DOT
            CALL WRITE_STRING
            MOV SI,SI
            SUB SI,22
            DISPLAY_PATH2: CALL WRITE_STRING
            RET

```

```

;-----

```

```

; INPUT: DS:SI -> Directory; BP=Index tree; BX=Bytes/cluster; Recursive Proc
; OUTPUT: CLUSTER_CNT=Total clusters of files; CF=1 if unsuccessful.

```

```

CALC BRANCH: PUSH BX
            CALL DOS_CURSOR

```


PRUNE.ASM

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```

MOV     CS, TOTAL_FILES, 0      ;Initialize variables.
MOV     DI, TREE_DRIVE[BP]      ;Log onto target drive
CALL    SELECT_DISK             ; and directory.
CALL    SELECT_DIR
JC      CALC_END
CALL    GET_NAME
CALL    GET_DIRS                ;Get size of branch.
CALL    PUSHY
CALL    HIDE_CURSOR
POPF    BX
CALL    CALC_END

;-----;
CALC_DIR: MOV     DX, SI
CALL    CHANGE_DIR
JC      DIR_END

GET_DIRS: PUSH    DS
MOV     AX, CS
MOV     DS, AX
MOV     ENTRY_CMT, 2             ;Dot and dot dot entries.
MOV     DE, OFFSET STAR_DOT_STAR
MOV     CX, 1
CMP     BRANCH_FLAG, 1          ;Normal, hidden and read-only.
JNZ     FIND_FIRST
OR      CX, 10H
MOV     AX, 4EH
INT     21H
JC      NEXT_FILE
JMP     SHORT CK_FILE

NEXT_FILE: MOV     AX, 4FH
INT     21H
JC      DIR_SPACE
CHK_FILE: BYTE PTR DS:[DATA.FILE_NAME], "." ;skip dot and dot dot.
JZ      NEXT_FILE
INC     ENTRY_CMT
TEST    DS:[DATA.ATTRIBUTE], 10H
JNZ     NEXT_FILE
INC     TOTAL_FILES

MOV     AX, DS:[DATA.SIZE_LOW]   ;Calculate cluster bytes
MOV     DX, DS:[DATA.SIZE_HIGH] ; for file.
CALL    CALC_TOTAL
JMP     NEXT_FILE

DIR_SPACE: MOV     AX, ENTRY_CMT
MOV     CX, 32
MUL     CX
CALL    CALC_TOTAL

ADD     SI, SIZE_TREE
CMP     BRANCH_FLAG, 1
POP     PC
CLC
JNZ     DIR_END

NEXT_SUB2: CMP     BYTE PTR [SI + 3], "-"
JNZ     DIR_NONE
INC     SI
INC     SI
CALL    CALC_DIR
JC      DIR_END
DEC     SI
DEC     SI
JMP     NEXT_SUB2

DIR_NONE: PUSH    DS
PUSH    CS
POP     DS
MOV     DX, OFFSET DOT_DOT
CALL    CHANGE_DIR
POP     DS
JMP     DIR_END

;-----;
; INPUT: DX:AX = file or subdir size; BX = Destination bytes/cluster.
CALC_TOTAL: DIV     BX
OR      DX, DX
JZ      SUB_TOTAL
INC     AX
ADD     SUB_TOTAL, AX
JMP     RET

SUB_TOTAL: RET

;-----;
; INPUT: DS:SI -> Source; ES:DI -> Destination; AL and AH = drive.
; Tree's contents of DS:SI and ES:DI are identical.
FAST_MOVE: OR      DI, DI
JZ      CR_IF_SAME
CMP     BRANCH[SI], "-"
JNZ     DO_FAST
JMP     FAST_ERROR

CR_IF_SAME: MOV     CX, BRANCH_NO[SI]
CMP     CX, BRANCH_NO[DI]
JNZ     DO_FAST

CMP     SI, DI
JNZ     SAVE_POINTER
JMP     FAST_ERROR
;Can't graft to same.

SAVE_POINTER: PUSH    SI
JZ      CE_ANCESTOR
;if below, see if in same branch.

CR_PARENT: MOV     DX, CS:SOURCE_BAR
CALL    SET_NAME
CALL    FIND_PARENT
POP     SI
CMP     DX, CS:BAR_LINE[BP]
JNZ     DO_FAST
JMP     FAST_ERROR

CK_ANCESTOR: MOV     SI, DI
CALL    SET_NAME
MOV     DX, CS:BAR_LINE[BP]
FIND_PARENT
JZ      CE_ANCESTOR
JMP     CK_ABOVE
ANCESTOR_ERR: MOV     DX, DTA.FILE_NAME
TEST    DS:[DATA.ATTRIBUTE], 1 OR 2

CE_ABOVE: JA      NEXT_ANCESTOR
SI
DO_FAST: CALL    CE_DUPLICATE
JNC     FAST_READY
JMP     FAST_END
;Can't graft if name already exists.

FAST_READY: MOV     AX, CS
MOV     DS, AX
MOV     ES, AX

CALL    CONFIRM
JNC     WORKING
JMP     FAST_END

WORKING: CALL    CLEAR_MENU
MOV     SI, OFFSET WORKING_MSG
CALL    WRITE_STRING

CALL    CREATE_TEMP
JNC     FAST_BOOT
JMP     FAST_ERROR2
;Create/delete to make sure there is a free space.

FAST_BOOT: CALL    GET_BOOT
JC      LILLY_ERR
CALL    GET_FAT
JC      FAST_ERROR

LILLY_ERR: MOV     REREAD_FLAG, 1
LES     DI, SOURCE_POINTER
MOV     DX, ES:TREE_CLUSTER[DI]
MOV     SI, OFFSET DOT_DOT
MOV     DI, LEN, 2
CALL    FIND_DIR
JC      LOGICAL_ERR

MOV     AX, ES:DIR_CLUSTER[DI]
MOV     OLD_PARENT, AX
LES     SI, BEST_POINTER
MOV     AX, TREE_CLUSTER[SI]
PUSH    DS
MOV     NEW_PARENT, AX
MOV     ES, DIR_CLUSTER[DI], AX
CALL    WRITE_SECTOR
;Change to new parent.

CALL    MAKE_SOURCE
MOV     DE, OLD_PARENT
MOV     BX, OFFSET SOURCE_RECORD
MOV     DI, LEN, 11
CALL    FIND_DIR
JC      FAST_ERROR
CALL    SAVE_SOURCE
MOV     ES, DIR_NAME[DI], 025H
CALL    WRITE_SECTOR
;Save the directory entry.
;Delete existing.

MOV     DX, NEW_PARENT
MOV     BX, OFFSET E5
MOV     DI, LEN, 1
CALL    FIND_DIR
JZ      FAST_ERROR
MOV     SI, OFFSET SOURCE_RECORD
MOV     CX, SIZE_DIR_ENTRY
MOV     REP
CALL    WRITE_SECTOR
;place directory entry in it's place.

FAST_END: RET

ANCESTOR_ERR: POP     SI
FAST_ERROR: MOV     SI, OFFSET ILLOGICAL_MSG
FAST_ERROR2: PUSH    CS
POP     DS
CALL    DISPLAY_ERROR
RET

LOGICAL_ERR: MOV     SI, OFFSET LOGICAL_MSG
JMP     FAST_ERROR2

;-----;
DELETE: PUSH    CS
POP     DS
CALL    CLEAR_MENU
MOV     SI, OFFSET DELETE_MSG
CALL    WRITE_STRING
MOV     REREAD_FLAG, 1

LES     SI, CS:SOURCE_POINTER
CALL    SELECT_DIR
JC      DELETE_END
CALL    GET_NAME
JMP     SHORT FIND_TOP

FIND_TOP: MOV     DI, 61
CALL    CHANGE_DIR
;Change to next subdr.

FIND_TOP: PUSH    DS
PUSH    SI
ADD     SI, SIZE_TREE
NEXT_TOP: CMP     BYTE PTR [SI + 1], "-"
JNZ     DO_FILES
JZ      NEXT_DELETE
;Is there a branch?

CMP     SI, DI
JNZ     DO_DELETE
JMP     NEXT_DELETE
;If yes, delete branch also.

DO_FILES: MOV     AX, CS
MOV     DS, AX
MOV     DX, OFFSET STAR_DOT_STAR
MOV     CX, 1 OR 2
MOV     AX, 4EH
INT     21H
JZ      REMOVE_SUBDIR
JMP     SHORT CK_ATTR
CK_ATTR: MOV     DX, DTA.FILE_NAME
TEST    DS:[DATA.ATTRIBUTE], 1 OR 2

```


PRUNE.ASM

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```

JN DELETE_FILE
XOR CX,CX
MOV AX,4191H ;Make normal attribute if
INT 21H ; not already so can be deleted.
JC DELETE_DONE

DELETE_FILE: MOV AX,41H ;Delete file.
INT 21H
JC DELETE_DONE
JMP NEXT_DELETE

REMOVE_SUBDIR: MOV DX,OFFSET DOT_DOT ;Return to parent directory.
CALL CHANGE_DIR ;(Can't remove a directory
POP DS ; while logged onto the
MOV CX,10H OR 2 ; directory.)
MOV AH,4EH ;Is directory hidden?
INT 21H
JC DELETE_END
TEST CB:[DATA.ATTRIBUTE],2
JN REMOVE_IT
XOR CX,CX
MOV AX,4301H ;If yes, make normal.
INT 21H

REMOVE_IT: MOV AX,1AH ;Remove subdirectory.
INT 21H
JMP SHORT DELETE_END

DELETE_DONE: POP DX
DELETE_END: RET

;-----;
; OUTPUT: CF=1 if can't create subdirectory.
;-----;

CREATE_TEMP: MOV DX,OFFSET TEMP ;Create subdirectory.
MOV AX,30H
INT 21H
JC TEMP_END
JMP REMOVE_DIR

REMOVE_DIR: MOV AX,1AH ;Remove subdirectory.
INT 21H
CALL DISK_FREE ;Update disk stats.
TEMP_END: MOV SI,OFFSET SUBDIR_MSG
RET

;-----;
; INPUT: DS:SI -> Source; DS = Sibling bar.
; OUTPUT: DS:SI -> Parent; DS = Parent bar.
;-----;

FIND_PARENT: DEC SI
DEC SI
NEXT_PARENT: SUB SI,SIBB_TREE
DEC DI
CMP SI,1
JE PARENT_END
CMP BYTE PTR [SI], "-"
JE NEXT_PARENT
CMP BYTE PTR [SI], "."
JE NEXT_PARENT
PARENT_END: RET

;-----;
; OUTPUT: CF=1 if dest dir has a subdir or file with name same as source dir.
;-----;

CK_DUPLICATE: PUSH DS
CALL DOS_CURSOR
MOV DL,Cs:TREE_DRIVE[BP]
CALL SELECT_DISK
LDS SI,Cs:DEST_POINTER ;Log on to destination.
CALL SELECT_DIR
MOV SI,OFFSET LOGICAL_MSG
JC DUP_ERR
LDS SI,Cs:SOURCE_POINTER
GET_NAME
MOV DX,SI
MOV CX,10H OR 1 ;Subdir, hidden, read-only
MOV AX,4EH ; or normal.
INT 21H ;Does it already exist?
JNC DUP_END
DUP_ERR: MOV SI,OFFSET DUPLICATE_MSG
CALL FAST_ERROR2
DUP_END: STC
POP DS
RETF

;-----;
; INPUT: DS:SI -> Record start. OUTPUT: DS:SI -> Directory name.
;-----;

GET_NAME: OR SI,SI
JE GET_NAME_END ;Root?
NEXT_NAME: LODSB
CMP AL,"-"
JNE NEXT_NAME
GET_NAME_END: RET

;-----;

DISPLAY_MARK: PUSH DS
MOV AX,BAR_LINE[BP]
MOV SOURCE_BAR,AX
MOV CX,SIBB_TREE
MUL CX
MOV DI,AX
MOV SOURCE_LINE,DI
MOV AX,TREE_SEG[BP]
MOV MARK_SEG,AX
MOV DS,AX
MOV MARK[DI],LITTLE_ARROW ;Mark selected line with
POP DS ; a little arrow.
CALL DISPLAY_TREE
RET

ERASE_MARK: PUSH DS
LDS DI,SOURCE_POINTER
XOR AL,AL
OR DI,DI
JNE REMOVE_ARROW
MOV AL," "
REMOVE_ARROW: MOV MARK[DI],AL ;Remove little arrow.
POP DS
RET

```

```

;-----;
; INPUT: DX = Starting cluster; DS:BX -> Dirname to find; DIR_LEN = length.
; OUTPUT: ES:DI -> Matching record; DX = Sector; CF=1 if failed.
;-----;

FIND_DIR: MOV AX,CLUSTER_SEG
MOV ES,AX
OR DX,DX
JN FIND_ROOT ;Special case if root.

NEXT_SOURCE: MOV LAST_CLUSTER,DX
MOV AX,DX
DEC AX
MOV CL,BPB_SectorsPerCluster
XOR CX,CX
MUL CX
ADD AX,DATA_SECTOR
ADC DX,0
MOV STARTING_SECTOR[2],DX
MOV DX,AX

NEXT_SECTOR2: PUSH CX
CALL FIND ;Find the record.
POP CX
JNC FIND_DIR_END
ADD DX,1
ADC STARTING_SECTOR[2],0 ;Next sector.
LOOP NEXT_SECTOR2

CALL CK_FAT
JNC NEXT_SOURCE
FIND_DIR_END: RET

;-----;
; Special case for root dirs.
;-----;

FIND_ROOT: MOV DX,ROOT_SECTOR ;Root sector is below
MOV CX,ROOT_SECTORS ; data sectors.
MOV STARTING_SECTOR[2],0

NEXT_ROOT2: PUSH CX
CALL FIND
POP CX
JNC ROOT_END
INC DX
LOOP NEXT_ROOT2
ROOT_END: RET

;-----;
; INPUT: ES -> Cluster seg; DS:BX -> Dirname to find;
; DX = Sector; DIR_LEN = length.
; OUTPUT: CF=0 if found; Else, DX = Next sector.
;-----;

FIND: PUSH BX
XOR BX,BX
MOV CX,1
MOV AX,CLUSTER_SEG
MOV TRANSFER_ADDRESS[2],AX
MOV DS,AX
CALL READ_DISK ;Read the sector.
PUSH CX
POP DS
POP BX
JC FIND_DONE

XOR DI,DI
MOV CX,SECTOR_RECORDS ;Records per sector.
JMP SHORT FIRST_TEMP
NEXT_TEMP: ADD DI,SIBB_DIR_ENTRY ;Next entry.
PUSH DI
MOV SI,BX
MOV CX,DIR_LEN
REPZ CMPSB ;Is it a match?
POP DI
POP CX
JNE FIND_TEMP
TEST ES:DIR_ATTR[DI],10H ;Is it a subdirc?
CLC
JNE FIND_END
JNE NEXT_TEMP
FIND_TEMP: LOOP NEXT_TEMP
FIND_DONE: STC
FIND_END: RET

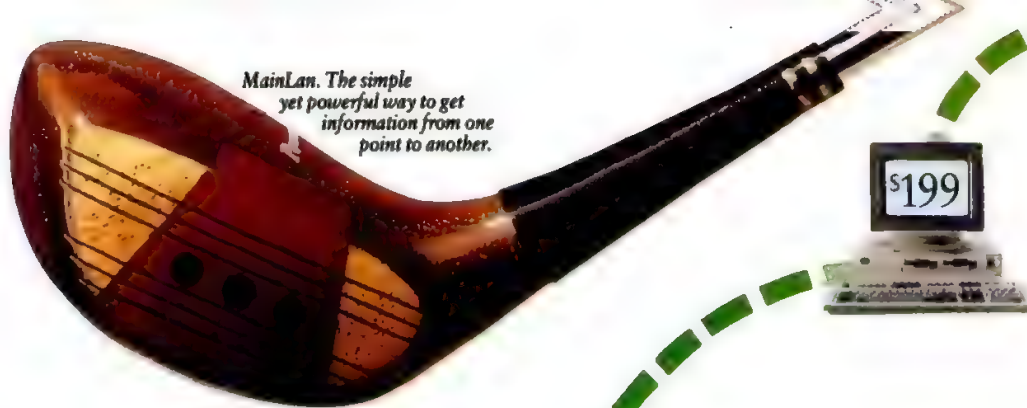
;-----;

MAKE_SOURCE: PUSH DS
LDS SI,SOURCE_POINTER
CALL GET_NAME
PUSH CS
POP ES
MOV DI,OFFSET SOURCE_RECORD ;Store name in directory
MOV CX,0 ;entry format that removes
NEXT_MAKE: LODSB ; the delimiting dot
CMP AL,"." ; and pads with spaces.
JE EXT2
OR AL,AL
JE EXT1
STOSB
NEXT_MAKE: LOOP NEXT_MAKE
CMP BYTE PTR [DI], "."
JNE EXT2
INC SI
JMP SHORT EXT2

EXT1: DEC SI
EXT2: MOV AL,SPACE
REP STOSB

NEXT_EXT: MOV LODSB
OR AL,AL
JE EXT_DONE
JNE NEXT_EXT
EXT_DONE: MOV AL,SPACE
REP STOSB
POP DS
RET

```

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; INPUT: ES:DI -> Source directory entry.

```

SAVE_SOURCE:  PUSH    DS          ;Save directory record.
               PUSH    ES
               PUSH    DI
               MOV     AX,ES
               MOV     DS,AX
               MOV     SI,DI
               MOV     DI,OFFSET SOURCE_RECORD
               PUSH    DS
               POP     ES
               MOV     CX,SIZE DIR_ENTRY
               REP     RETN
               POP     DS
               RET

```

; INPUT: SI -> Message.

```

DISPLAY_ERROR: CALL    CLEAR_MENU
               CALL    WRITE_STRING
               MOV     SI,OFFSET ANYKEY_MSG
               CALL    WRITE_STRING
               CALL    BEEP
               CALL    HIDE_CURSOR
               CALL    CLEAR_KEY
               CALL    GET_KEY          ;Pause.
               CALL    DISPLAY_MENU
               STC
               RET

```

; OUTPUT: DI -> Start of window; BH=Menu color.

```

CLEAR_MENU:   MOV     AL,ROWS          ;Menu row.
               DEC     AL
               MOV     DH,AL
               MOV     CH,AL
               MOV     CL,CL
               MOV     DL,79          ;Menu width.
               PUSH    AX
               MOV     BH,COLOR_C     ;Error color.
               CALL    DO_CLEAR
               POP     AX
               XOR     AH,AH
               CALL    CALC_ADDR
               RET

```

; INPUT: BP=Tree Index; AX=DIR COUNT; CX=BAR LINE; DX=LISTING_TOP
DI=Listing Bottom; SI=Listing Length

```

UP:           MOV     BX,-1          ;Up a line.
               JMP     SHORT DO_ARROW

DOWN:         MOV     BX,1          ;Down a line.
DO_ARROW:     ADD     CX,BX
CR_ARROW1:    OR      CX,CX
               JNS     CR_ARROW2
               XOR     CX,CX
CR_ARROW2:    CMP     CX,AX
               JBE     CR_PAGE
               MOV     CX,AX
               CMP     CX,DX
               JB      ADJUST_PAGE
               CMP     CX,DI
               JBE     NAVIGATE_DONE
ADJUST_PAGE:  ADD     DX,BX
               JMP     SHORT NAVIGATE_DONE

PGUP:         NEG     SI            ;Up a page
PGDN:         ADD     CX,SI          ;Down a page.
               ADD     DX,SI
               JNS     CR_PGDN
               XOR     DX,DX
CR_PGDN:      XOR     BX,BX
               CMP     DX,AX
               JBE     CR_ARROW1
               SUB     DX,SI
               JMP     CR_ARROW1

NONE:         XOR     CX,CX          ;None
               XOR     DX,DX
               JMP     SHORT NAVIGATE_DONE

END_KEY:      MOV     CX,AX          ;End.
               DEC     SI
               SUB     DI,SI
               CMP     DI,DX
               JB      NAVIGATE_DONE
               MOV     DX,AX
               SUB     DX,SI
               JNS     NAVIGATE_DONE
               XOR     DX,DX

NAVIGATE_DONE: MOV     BAR_LINE[BP],CX
               MOV     LISTING_TOP[BP],DX
               CALL    DISPLAY_TREE
NAVIGATE_END: RET

```

; INPUT: BP = Tree Index. OUTPUT: CF = 0 if successful.

```

TAB_KEY:     XOR     ACTIVE_TREE,2
               JMP     SHORT CHANGE_TREE

LEFT:        MOV     ACTIVE_TREE,0
               JMP     SHORT CHANGE_TREE

RIGHT:       MOV     ACTIVE_TREE,2
CHANGE_TREE: MOV     BP,ACTIVE_TREE
               XOR     BP,2
               CALL    DISPLAY_DRIVE
               XOR     BP,2
               CALL    DISPLAY_DRIVE
               RET

; INPUT: BP = Tree Index. OUTPUT: CF = 0 if successful.
READ_DRIVE:  CALL    DOS_CURSOR
               MOV     DL,TREE_DRIVE[BP] ;Retrieve drive.

```

```

               INC     DL            ;Adjust.
               MOV     AH,32H        ;Retrieve Disk Block.
               INT     21H          ;BIOS disk block drive no.
               MOV     DS,(BX)
               PUSH    CS
               POP     DS
               OR      AL,AL        ;Does disk request exist?
               JZ      EXISTS

```

```

READ_ERROR:  PUSH    CS
               POP     ES
               STC
               RET

```

```

EXISTS:      DEC     DL            ;Substituted?
               CMP     DL,DH
               JNE     READ_ERROR
               CALL    GET_BOOT
               CALL    READ_ERROR
               JC

```

```

               MOV     SI,OFFSET UNNAMED
               MOV     DI,VOLUME_NAME[BP]
               MOV     CX,VOLUME_LEN
               REP     MOVSB
               CALL    GET_ROOT
               JZ      READ_END      ;If none, done here.
               CALL    GET_FAT
               JNC     GET_SUBS
               JMP     READ_ERROR

```

; INPUT: BX = Root directory entries.

```

GET_SUBS:    XOR     SI,SI
UP_LEVEL:    MOV     CX,BX          ;Retrieve record count.
               ADD     TREE_LEVEL,2 ;Bump point to next level.
               MOV     BX,TREE_LEVEL
               MOV     [WORD PTR LEVEL_ADDRESS + BX],DI ;Save level address.
               XOR     BX,BX        ;Zero out entry counter.
               MOV     DX,ES:CLUSTER[SI] ;Retrieve starting cluster.

NEXT_SECTOR: MOV

NEXT_CLUSTER: MOV     LAST_CLUSTER,DX ;And save.
               PUSH    CX          ;Save some registers.
               PUSH    BX
               CALL    READ_CLUSTER ;Retrieve directory sector.
               POP     BX
               MOV     DX,ES:ENTRY[SI] ;Retrieve parent entry number.
               PUSH    SI
               MOV     CX,CLUST_RECORDS ;Retrieve records per cluster.
               CALL    STORE_RECORD ;Store subdirectories.
               POP     SI
               POP     CX
               JC      END_LEVEL    ;If carry, last entry found.
               CALL    CR_FAT       ;Else, get next cluster.
               JNC     NEXT_CLUSTER ;If carry, last cluster found.

END_LEVEL:   ADD     SI,SIZE_TREE_DATA ;Else, point to next root entry.
               LOOP    NEXT_SECTOR ;Find next subdirectory.
               CMP     SI,DI        ;Did we find any at this level?
               JZ      UP_LEVEL     ;If yes, continue.
               MOV     AX,0FFFFH    ;Else, done; mark with signature.
               STOSB

BX,TREE_LEVEL
MOV     [WORD PTR LEVEL_ADDRESS + BX*2],AX ;Mark level address.
CALL    SORT                      ;Alphabetize by level.

READ_END:    CALL    DISK_FREE     ;Get disk state.
               JC      READ_ERROR
               CALL    FORMAT      ;Format into tree.
               CALL    CR_VARS
               PUSH    CS
               POP     ES
               CLC

READ_DONE:   RET

```

; INPUT: BP = Tree Index.

; OUTPUT: BIG_DISK_FLAG=1 if >32 Meg; CF=1 if failed.

```

GET_BOOT:    MOV     BIG_DISK_FLAG,0 ;Assume small disk (<32Meg.)
NEXT_BOOT:   PUSH    DS
               MOV     CX,1
               MOV     DX,DX
               MOV     STARTING_SECTOR[2],0 ;Sector zero.
               XOR     BX,BX        ;High half.
               MOV     AX,CLUSTER_SEC ;offset zero transfer address.
               MOV     MOV     DX,AX
               MOV     BYTE PTR [BX],0 ;Zero to detect bad read.
               CALL    READ_DISK
               POP     DS
               JNC     STORE_BOOT
               CMP     BIG_DISK_FLAG,1
               MOV     BIG_DISK_FLAG,1
               JRE     NEXT_BOOT
               STC
               JMP     SHORT BOOT_END

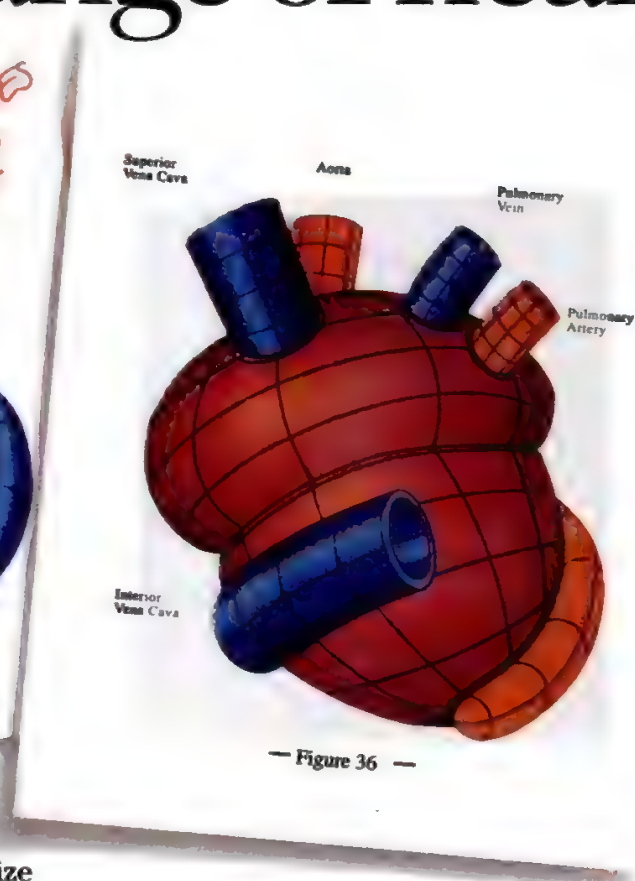
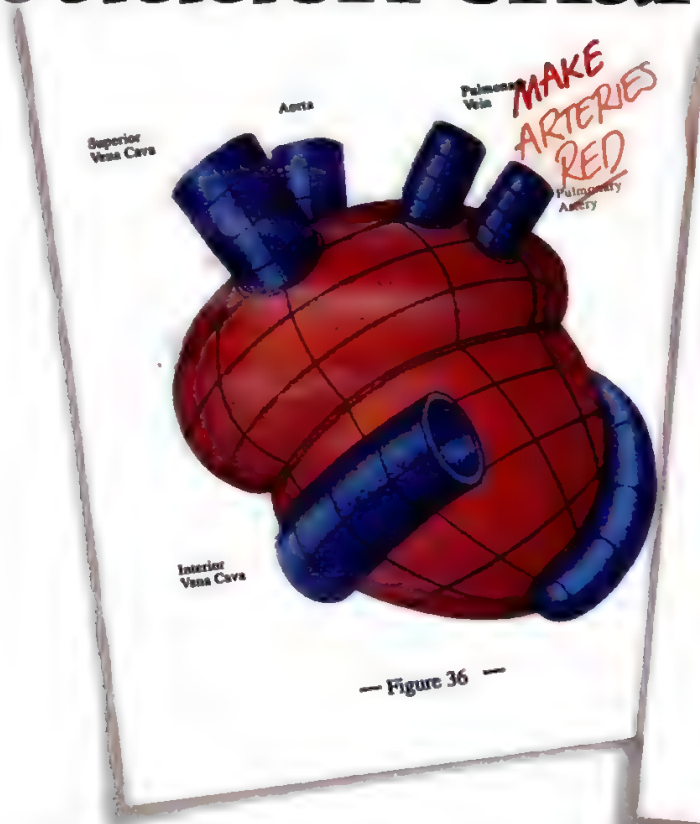
STORE_BOOT:  MOV     DS,CLUSTER_SEC
               CMP     BYTE PTR DS:[0],0
               STC
               MOV     SI,1
               MOV     DI,OFFSET BPB ;Start of BPB in boot record.
               MOV     CX,BPB_LENGTH
               REP     MOVSB

               PUSH    CS
               POP     DS
               MOV     FAT_TYPE,FAT_16_BIT ;17 or 16 bit FAT?
               MOV     CL,BPB_SectorsPerCluster
               XOR     CX,CX
               MOV     AX,BPB_TotalSectors
               OR      AX,AX
               JS      GET_RECORDS
               XOR     DX,DX
               DIV     CX
               CMP     AX,4886
               JAE     GET_RECORDS
               MOV     FAT_TYPE,FAT_12_BIT

GET_RECORDS: MOV     AX,BPB_BytsPerSector ;Retrieve bytes per sector.

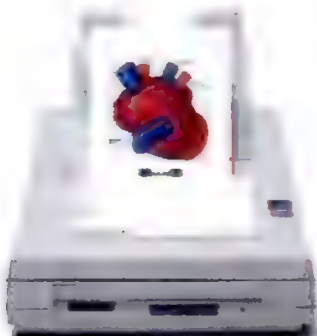
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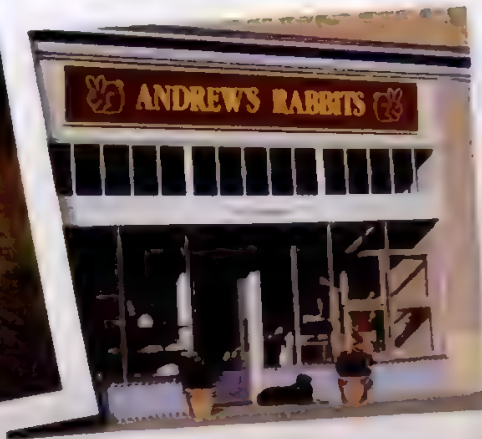
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```

XOR     DX,DX
MOV     BX,SIZE DIR_ENTRY
DIV     BX
MOV     SECTOR_RECORDS,AX
MUL     CX
MOV     CLUST_RECORDS,AX
;Times sector per cluster.

MOV     AX,BPB_RootEntries
;Retrieve number of root entries.
MUL     BX
DIV     BPB_BytesPerSector
;Divide by bytes per sector.
MOV     ROOT_SECTORS,AX
;That's root length in sectors.

ADD_FATS:
MOV     AX,BPB_ReservedSectors
MOV     CL,BPB_NumberOfFats
XOR     CH,CH
ADD     AX,BPB_SectorsPerFat
LOOP    ADD_FATS

MOV     ROOT_SECTOR,AX
ADD     AX,ROOT_SECTORS
MOV     DATA_SECTOR,AX
;AX = directory sectors.

CLC

BOOT_END:
PUSH    CS
POP      DS
RET

```

```

;-----;
; INPUT: BX=Root directory entries; IF=1 if none.
; OUTPUT: CX=Root directory entries; IF=1 if none.

```

```

GET_ROOT:
MOV     ES,TRAIL_DATA_SEG[BP]
XOR     DI,DI
MOV     BYTE PTR ES:[DI],0FFh
MOV     WORD PTR ES:[DI],0FFh
XOR     BX,BX
MOV     TREE_LEVEL,AX
MOV     DX,ROOT_SECTOR
MOV     CX,ROOT_SECTORS

NEXT_ROOT:
PUSH    BX
PUSH    CX
MOV     CX,1
XOR     BX,BX
MOV     STARTING_SECTOR[2],BX
MOV     AX,CLUSTERS_SEG
MOV     TRANSFER_ADDRESS[2],AX
MOV     DS,AX
CALL    READ_DISK
PUSH    DS
POP      DS

POP      BX
MOV     CX,SECTOR_RECORDS
CALL    STORE_RECORD
;store them in database.
INC     DX
POP      CX
MOV     NEXT_ROOT
JNZ     NEXT_ROOT
;BX returns with no. entries.

```

```

;-----;
; OUTPUT: CX = 1 if failed. BX preserved.

```

```

GET_FAT:
PUSH    BX
MOV     DX,BPB_ReservedSectors
MOV     CX,BPB_SectorsPerFat
MOV     BX,FAT_SEG

NEXT_FAT:
PUSH    BX
PUSH    CX
PUSH    DX

MOV     STARTING_SECTOR[2],0
MOV     TRANSFER_ADDRESS[2],BX
MOV     DS,BX
XOR     BX,BX
MOV     CX,1
CALL    READ_DISK
PUSH    DS
POP      DS
JNC     FAT_OK
ADD     SP,6
STC
JMP     SHORT FAT_END

FAT_OK:
POP      DX
INC     BX
MOV     AX,BPB_BytesPerSector
MOV     CL,4
SHR     AX,CL
MOV     CX,AX
;Paragraphs per sector.
POP      CX
POP      BX
ADD     BX,AX
LOOP    NEXT_FAT
CLC

FAT_END:
POP      BX
RET

```

```

;-----;
; INPUT: CX = No. of Sectors; DX = Logical Sector; DS:BX -> Transfer Address.
; OUTPUT: CF = 0 if successful; CF = 1 if failed.

```

```

READ_DISK:
PUSH    BP
PUSH    SI
PUSH    DI
MOV     AL,CS:TRAIL_DRIVE[BP]
MOV     CH,BIG_DISK_FLAG,0
MOV     DS,TRAIL_READ_SEG
MOV     TRANSFER_ADDRESS[0],BX
MOV     STARTING_SECTOR[0],DX
MOV     NUMBER_OF_SECTORS,CH
MOV     CX,-1

DIRECT_READ:
INT     25h
POP      AX
;Read the sectors.
;Get rid off flags left on stack.

```

```

PUSH    DI
PUSH    SI
PUSH    DX
PUSH    BP
MOV     AH,0dh
INT     21h
RET

```

```

;-----;
; INPUT: DX = Logical Sector.
; OUTPUT: CF = 0 if successful; CF = 1 if failed.

```

```

WRITE_SECTOR:
MOV     AH,0dh
INT     21h
PUSH    BP
PUSH    DS
MOV     BX,BX
MOV     CX,1
MOV     AL,TRAIL_DRIVE[BP]
MOV     CH,BIG_DISK_FLAG,0
MOV     DS,CLUSTERS_SEG
MOV     DIRECT_WRITE

PUSH    DS
POP      DS
MOV     BX,OFFSET PACKET
MOV     CX,-1

```

```

DIRECT_WRITE:
INT     26h
POP      AX
;Write the sector.
;Get rid off flags left on stack.

```

```

PUSH    DS
POP      DS
MOV     AH,0dh
INT     21h
RET

```

```

;-----;
READ_CLUSTER:
MOV     BX
MOV     AX,AX
DEC     AX
DEC     AX
MOV     CL,BPB_SectorsPerCluster
MOV     CH,CH
MUL     CX
;Retrieve cluster number.
;Subtract to reflect cluster
; 2 as first logical data sector.
;Retrieve sectors per cluster.
;Multiply to get sector start.

ADD     AX,DATA_SECTOR
ADC     DX,0
MOV     STARTING_SECTOR[2],DX
MOV     DS,AX
XOR     BX,BX
MOV     AX,CLUSTERS_SEG
MOV     TRANSFER_ADDRESS[2],AX
MOV     DS,AX
CALL    READ_DISK
;And get data.
PUSH    CS
POP      DS
POP      BX
RET

```

```

;-----;
; This subroutine stores the level number, entry number, parent
; entry number, the directory name and attribute byte in database.
; INPUT: CX=Directory records; BX=Level; DX=Parent; ES:DI -> Tree_data storage.

```

```

STORE_RECORD:
PUSH    DS
XOR     SI,SI
MOV     DS,CLUSTERS_SEG
CMP     BYTE PTR ES:[SI],0
JZ     STORE_RETURN
TEST    DIR_ATTR[SI],8
JZ     STORE_RETURN
;No more entries?
;If yes, done here.
;Is it a volume label?
TEST    DIR_ATTR[SI],16h
JZ     STORE_RETURN
;Is it a directory?
JZ     STORE_RETURN
;If no, next entry.
CMP     DIR_NAME[SI],0x5
JZ     STORE_RETURN
;Is it a removed directory?
;If yes, skip.
CMP     DIR_NAME[SI],0
JZ     STORE_RETURN
;Is it a dot or dot-dot entry?
;If yes, skip.

```

```

PUSH    DS
MOV     AX,CS:TRAIL_LEVEL
;Store level number.
STOSB
MOV     AX,BX
;Store entry number.
STOSB
MOV     AX,DX
;Store parent entry number.
STOSB
PUSH    CX
MOV     CX,11
REP     MOVSB
;Store 11 bytes of name.
POP      CX
ADD     SI,15
;Store starting cluster.
MOVESB
INC     BX
;Increment entry count.
POP      SI
XOR     AX,AX
TEST    DIR_ATTR[SI],2
JZ     STORE_ATTRIB
;Assume not a hidden directory.
;Is it hidden?
;If no, store null.
MOV     AX,0
;Else, store 'H'
STOSB

```

```

STORE_ATTRIB:
ADD     SI,SIZE DIR_ENTRY
MOV     DS,TRAIL_READ_SEG
MOV     TRANSFER_ADDRESS[0],BX
MOV     STARTING_SECTOR[0],DX
MOV     NUMBER_OF_SECTORS,CH
MOV     CX,-1

LOOP_STORE:
LOOP    LOOP_STORE
;Point to next entry.
POP      DS
CLC
;Indicate full sector.
RET

STORE_RETURN:
STC
POP      DS
RET

```

```

STORE_VOLUME:
CMP     DIR_NAME[SI],0x5
JZ     STORE_RETURN
;Is it a removed volume?
;If yes, skip.

```

```

PUSH    DI
PUSH    DS
PUSH    SI
PUSH    CX
MOV     DI,CS:VOLUME_NAME[BP]
MOV     CX,VOLUME_LEN

```



```

;-----;
; This subroutine formats the database into a directory tree.

```

[illegible]

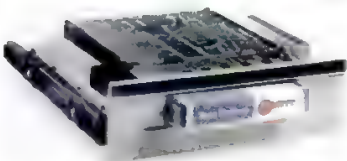
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CIRCLE 473 ON READER SERVICE CARD

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; Add logic to store spaces after first non-space char.

```

STORE_BYTES:  LODSB                ;Store all non space name
               CMP     AL,SPACE    ; characters.
               JZ      SKIP_STORE
               STOSB
SKIP_STORE:   LOOP  STORE_BYTES
               RET

```

;-----;

; INPUT: BP = Tree Index

```

DISPLAY_TREE: CALL  SETUP_COLOR
               PUSH  BP
               MOV   AX,LISTING_TOP(BP)
               MOV   CX,SIZE_TREE
               MUL   SI,AX
               MOV   AX,2
               CALL  CALC_COL
               MOV   DX,LISTING_TOP(BP)
               MOV   BX,TREE_COLOR
               MOV   CX,LISTING_LEN
               CMP   BP,ACTIVE_TREE
               MOV   DX,TREE_SEG(BP)
               MOV   BP,CX:BAR_LINE(BP)
               JE    NEXT_DISPLAY
               MOV   BP,-1          ;Turn off highlight bar.

```

```

NEXT_DISPLAY: PUSH  CX
               PUSH  DX
               PUSH  SI
               PUSH  DI
               MOV   CX,SIZE_MARK + SIZE_BRANCH
               CMP   DX,BP
               JNZ  NEXT_DISP1

```

```

OR            DX,DX                ;Is it the root?
JZ            HIGHLIGHT
BAR:          LODSB
               DEC   EH
               CALL  WRITE_SCREEN
               CMP   BL,"-"
               JNZ  BAR

```

```

HIGHLIGHT:   MOV   BH,CX:COLOR.C
NEXT_HIGH:   LODSB
               OR   AL,AL
               JS   BAR_END
               CALL  WRITE_SCREEN
               LOOP  NEXT_HIGH
               JMP   SHORT LOOP_DISPLAY

```

```

BAR_END:     MOV   BH,CX:TREE_COLOR
               DEC   SI
NEXT_BAR_END: LODSB
               CALL  WRITE_SCREEN
               LOOP  NEXT_BAR_END
               JMP   SHORT LOOP_DISPLAY

```

```

NEXT_DISP1:  LODSB
               CALL  WRITE_SCREEN
               LOOP  NEXT_DISP1

```

```

LOOP_DISPLAY: POP   DI
               ADD   DI,CX:CRT_WIDTH
               POP   SI
               ADD   SI,SIZE_TREE
               POP   DX
               INC   DX
               POP   CX
               LOOP  NEXT_DISPLAY
               POP   BP
               POP   IH
               RET

```

;-----;

; INPUT: BP = Tree Index

```

DISPLAY_DRIVE: CALL  SETUP_COLOR
               MOV   AL,TREE_DRIVE(BP)
               ADD   AL,"A"
               MOV   DRIVE_LETTER,AL
               MOV   AX,1
               CALL  CALC_COL
               MOV   BH,TREE_COLOR
               MOV   SI,OFFSET_DRIVE_SPEC
               CALL  WRITE_STRING
               MOV   SI,VOLUME_NAME(BP)
               CALL  WRITE_STRING

```

;-----;

```

STATS:       MOV   AL,ROWS
               SUB   AL,1
               XOR   AH,AH
               CALL  CALC_COL
               ADD   DI,14
               PUSH  DI
               MOV   AX,DIRECT_COUNT(BP)
               CALL  DISP_STATS
               MOV   SI,OFFSET_DIRECTORIES
               CALL  WRITE_STRING
               POP   DI
               ADD   DI,CRT_WIDTH
               PUSH  DI
               MOV   AX,TOTAL_CLUSTERS(BP)
               MUL   BYTES_CLUSTERS(BP)
               CALL  DISP_STATS
               MOV   SI,OFFSET_BYTES
               CALL  WRITE_STRING
               MOV   SI,OFFSET_TOTAL
               CALL  WRITE_STRING
               POP   DI
               ADD   DI,CRT_WIDTH
               PUSH  DI

```

```

MOV   AX,TOTAL_CLUSTERS(BP)
SUB   AX,FREE_CLUSTERS(BP)
PUSH  AX
MUL   BYTES_CLUSTERS(BP)
CALL  DISP_STATS
MOV   SI,OFFSET_BYTES
CALL  WRITE_STRING
MOV   SI,OFFSET_USED
CALL  WRITE_STRING
POP   AX
CALL  DISP_PERCENT
POP   DI
ADD   DI,CRT_WIDTH

```

```

MOV   AX,BYTES_CLUSTERS(BP)
MUL   FREE_CLUSTERS(BP)
CALL  DISP_STATS
MOV   SI,OFFSET_BYTES
CALL  WRITE_STRING
MOV   SI,OFFSET_FREE
CALL  WRITE_STRING
MOV   AX,100
MOV   AX,FREE_CLUSTERS(BP)
CALL  DISP_PERCENT
CALL  DISPLAY_TREE

```

DRIVE_END: RET

;-----;

; INPUT: AX = CLUSTERS

```

DISP_PERCENT: PUSH  BP
               MOV   SI,100
               MUL   SI
               MOV   BP,TOTAL_CLUSTERS(BP)
               DIV   BP
               SHL   DX,1
               INC   DX
               SUB   BP,DX
               ADC   AX,0

```

```

CMP   AX,100
JNZ  DO_PERCENT
MOV   SI,OFFSET_PERCENT_100
CALL  WRITE_STRING
JMP   SHORT PERCENT_END

```

```

DO_PERCENT:  PUSH  AX
               MOV   AL,SPACE
               CALL  WRITE_SCREEN
               POP   AX
               CALL  DECIMAL_ASCII
DO_PERCENT2: MOV   AL,"%"
PERCENT_END: CALL  WRITE_SCREEN
               POP   BP
               RET

```

;-----;

; INPUT: DX:AX = number; DI -> Display

```

DISP_STATS:  PUSH  BP
               PUSH  DX
               MOV   BP,DX
               MOV   SI,AX
               XOR   CX,CX
               MOV   BX,10
               JMP   SHORT DO_DIV

```

```

NEXT_DIV:    CMP   CX,3
               JNE  DO_DIV
               MOV   AL,"."
               PUSH  AX
               XOR   CX,CX
               INC   CL

```

```

DO_DIV:      MOV   AX,BP
               XOR   DX,DX
               DIV   BX
               MOV   BP,AX
               MOV   AX,SI
               DIV   BX
               MOV   SI,AX
               MOV   AX,DX
               ADD   AL,"0"
               PUSH  AX
               ADD   CX,SIZE
               OR   BP,BP
               JNZ  NEXT_DIV
               OR   SI,SI
               JNZ  NEXT_DIV

```

```

NOR   CX,CX
SUB   DI,CX
SUB   DI,CX
MOV   BH,TREE_COLOR
POP   AX
CALL  WRITE_SCREEN
LOOP  NEXT_WRITE
POP   BX
POP   BP
RET

```

;-----;

; INPUT: AX = Number.

```

DECIMAL_ASCII: MOV  DL,10
               DIV  DL
               ADD  AX,"0" SHL 8 + "0"
               PUSH AX
               CMP  AL,"0"
               JNE  DO_DECIMAL
               MOV  AL,SPACE
DO_DECIMAL:   CALL  WRITE_SCREEN
               POP  AX
               MOV  AL,AH
               CALL  WRITE_SCREEN
               RET

```

;-----;

```

SETUP_COLOR: MOV   AL,COLOR.I
               CMP   BP,ACTIVE_TREE
               JS   STORE_COLOR
               MOV   AL,COLOR.W
STORE_COLOR:  MOV   TREE_COLOR,AL
               RET

```


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```
; INPUT: BP = Tree index; CX = Starting row; AL = Size.
```

```
CLEAR_WINDOW: MOV     DS,CX
                ADD     DS,AL
                MOV     CX,CL
                OR      BP,BP
                JS      CLEAR
                MOV     CL,41
                MOV     DL,CL
                ADD     DL,8
                MOV     BP,TREE_COLOR
DO_CLEAR:      MOV     AX,409EH
                PUSH    BP
                INT     10H
                POP     BP
                RET
```

```
SETUP:         MOV     DI,OFFSET READING
                CALL    PRINT_STRING
                MOV     BP,BP
                MOV     CX,READ_DRIVE
                JC      INVALID
                MOV     AL,TREE_DRIVE[BP]
                INC     BP
                INC     BP
                MOV     AL,TREE_DRIVE[BP]
                JMP     READ_SECOND
```

```
READ_SECOND:   CALL    READ_DRIVE
                JNC     DO_VIDEO
                JMP     PARSE_ERROR
```

```
INVALID:       JMP     PARSE_ERROR
```

```
DO_VIDEO:     CALL    VIDEO_SETUP
```

```
UPDATE_TREE:  MOV     BP,BP
WENT_TREE:    CALL    CLEAR_DRIVE
                CALL    DISPLAY_DRIVE
                INC     BP
                INC     BP
                CMP     BP,2
                JEA     WENT_TREE
                MOV     BP,ACTIVE_TREE
                RET
```

```
DUP_TREE:     PUSH    DS
                PUSH    ES
                MOV     SI,OFFSET VOLUME1
                MOV     DI,OFFSET VOLUME2
                MOV     CX,VOLUME_LEN
                REP     MOVSB
                MOV     AX,DIR_COUNT[8]
                MOV     DIR_COUNT[2],AX
                MOV     AX,FREE_CLUSTERS[8]
                MOV     FREE_CLUSTERS[2],AX
                MOV     AX,TOTAL_CLUSTERS[8]
                MOV     TOTAL_CLUSTERS[2],AX
                MOV     AX,BYTES_CLUSTERS[8]
                MOV     BYTES_CLUSTERS[2],AX
                MOV     ES,TREE_SEG[2]
                MOV     DS,TREE_SEG[0]
                XOR     SI,SI
                XOR     DI,DI
                MOV     CX,MAX_ENTRIES * SIZE_TREE
                SHL     CX,1
                REP     MOVSB
                ADD     CX,CX
                REP     MOVSB
                POP     ES
                POP     DS
                CALL    CR_VARS
                RET
```

```
CR_VARS:      PUSH    ES
```

```
WENT_VARS:    MOV     ES,TREE_SEG[BP]
                MOV     AX,SIZE_TREE
                MUL     BAR_LINE[BP]
                MOV     DI,AX
                INC     DI
                MOV     AL,AL
                MOV     CX,SIZE_TREE - 1
                REP     MOVSB
                JNB     FREE_SPACE
                MOV     BAR_LINE[BP]
                MOV     AX,BAR_LINE[BP]
                CMP     AX,LISTING_TOP[BP]
                JAE     WENT_VARS
                DEC     LISTING_TOP[BP]
                JMP     WENT_VARS
VARS_END:     POP     ES
                RET
```

```
CLEAR_DRIVE:  CALL    SETUP_COLOR
                MOV     CX,1
                MOV     AL,AL
                CALL    CLEAR_WINDOW
                MOV     CX,ROWS
                SUB     CX,5
                MOV     AL,3
                CALL    CLEAR_WINDOW
                RET
```

```
; INPUT: DS:SI -> Directory record. OUTPUT: CF=1 if failed.
```

```
SELECT_DIR:   PUSH    SI
                PUSH    DS
                MOV     AX,CX
                MOV     DS,AX
                MOV     DI,OFFSET ROOT_DIR
                CALL    CHANGE_DIR
                POP     DS
```

```
                MOV     SI,SI
                JS      SELECT_END
                CALL    GET_NAME
                MOV     CX,CX
                ;Zero in level counter.
```

```
NEXT_SUBDIR:  PUSH    SI
                INC     CX
                CALL    FIND_PARENT
                CMP     SI,1
                JA      NEXT_SUBDIR
```

```
CHANGE_TREE:  POP      DI
                CALL    CHANGE_DIR
                JC      RESTORE_STACK
                LOOP    CHANGE_TREE
                CLC
                POP     SI
                RET
```

```
NEXT_STACK:   POP     DI
RESTORE_STACK: LOOP    NEXT_STACK
                STC
                POP     SI
                RET
```

```
; INPUT: AL=Drive Letter; BP = Tree index; SI -> *-
; OUTPUT: DI=Drive Number; BP=0 if exists
```

```
DRIVERLIST:   MOV     DI,AL
                AND     DI,5FH
                SUB     DI,"A"
                CMP     BYTE PTR [SI]," "
                JNE     DRIVERLIST_END
                CMP     BYTE PTR [SI+1],SPACE
                JA      DRIVERLIST_END
                DEC     SI
                MOV     DI,DEFAULT_PATH[BP]
                MOV     AX,2900H
                INT     21H
                MOV     DI,AX
                RET
```

```
; INPUT: BP = Tree index.
```

```
RESTORE_DIR:  MOV     DI,TREE_DRIVE[BP]
                MOV     AX,60H
                INT     21H
                MOV     DI,DEFAULT_PATH[BP]
                CALL    CHANGE_DIR
                RET
```

```
VIDEO_SETUP:  PUSH    ES
                MOV     AX,500H
                INT     10H
                MOV     AX,40H
                MOV     ES,AX
                MOV     AX,ES:CRT_COLS
                MOV     COLUMNS,AX
                SHL     AX,1
                MOV     CRT_WIDTH,AX
                MOV     AX,ES:(40H)
                MOV     CRT_START,AX
```

```
                MOV     AX,ES:(63H)
                ADD     AX,6
                MOV     CH,00000H
                MOV     AX,3000H
                JS      STORE_SEG
                ADD     CX,000H
STORE_SEG:    MOV     STATUS_REG,AX
                MOV     VIDEO_SEG,CX
                MOV     SI,OFFSET MONO_ATTR
                MOV     AL,ES:CRT_MODE
                CMP     AL,7
                JE      GET_ROWS
                CMP     AL,2
                JE      GET_ROWS
                MOV     SI,OFFSET COLOR_ATTR
                CMP     AL,3
                JE      GET_ROWS
                MOV     AX,3
                INT     10H
```

```
GET_ROWS:     MOV     BH,BH
                MOV     DL,24
                MOV     AX,1100H
                INT     10H
                MOV     ROWS,DL
                MOV     DL,7
                MOV     ROWS,DI
                MOV     LISTING_LEN,DI
```

```
                POP     ES
                MOV     DI,OFFSET COLOR
                MOV     CX,SIZE_COLOR_ATTRS
                REP     MOVSB
```

```
DISPLAY_SETUP: CALL    CLS
                ;Clear screen.
```

```
                CMP     BORDER_FLAG,1
                JE      DO_COPYRIGHT
                MOV     BL,COLOR.W
                AND     BL,7
                MOV     BH,BH
                MOV     AH,00H
                INT     10H
```

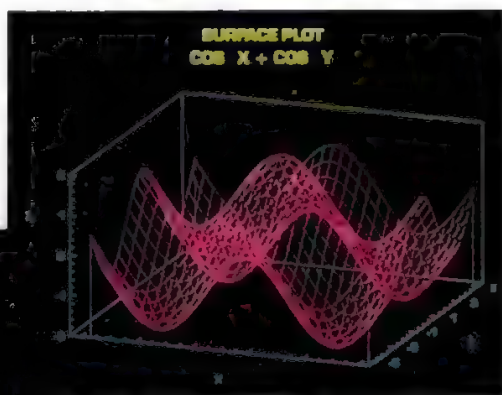
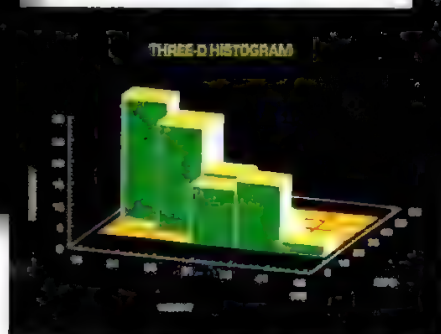
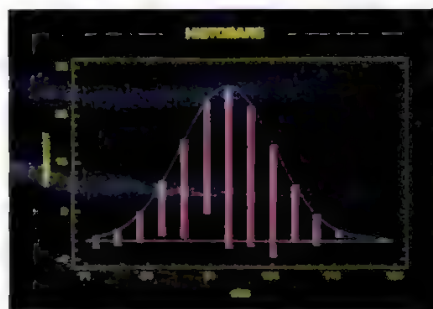
```
DO_COPYRIGHT: MOV     AX,AX
                CALL    CALC_ADDR
                INC     DI
                MOV     SI,OFFSET COPYRIGHT
                MOV     BH,COLOR.B
                CALL    WRITE_STRING
                MOV     AL,BH
                CALL    WRITE_SCREEN
                MOV     AL,SPACE
                CALL    WRITE_SCREEN
                INC     SI
                CALL    WRITE_STRING
                ;Bump pointer past LF
                ; and display rest of header.
```


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CIRCLE 506 ON READER SERVICE CARD

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```

DIV      BX,AX                      ;8253 countdown.
MOV      CALL      DELAY              ;Wait till clock rolls over.

MOV      AL,886H                    ;Channel 2 speaker functions.
OUT      43H,AL                      ;8253 Mode Control.
JMP      $+2                          ;IO delay.
MOV      AX,BX                      ;Retrieve countdown.
OUT      42H,AL                      ;Channel 2 LSB.
JMP      $+2
MOV      AL,AH                      ;Channel 2 MSB.
OUT      42H,AL                      ;Port B.
IN       AL,61H                      ;Port B.
OR        AL,3                      ;Turn on speaker.
JMP      $+2
OUT      61H,AL

CALL     DELAY                      ;Delay one second.
IN       AL,61H                      ;Get Port B again.
AND      AL,NOT 3                   ;Turn speaker off.
JMP      $+2
OUT      61H,AL
RET                                     ;Done.

;-----;
DELAY:   PUSH     DS                  ;Preserve data segment.
MOV      AX,40H                      ;Point to BIOS data segment.
MOV      DS,AX

NEXT_BEEP: MOV     AL,DS:[6CH]        ;Retrieve timer low.
MOV      DX,DS:[6CH]                ;Retrieve timer low.
CMP      DX,AX                      ;Have we timed out?
JE        NEXT_BEEP                 ;If not, wait until second up.
POP      DS                          ;Restore data segment.

;-----;
CLS:     MOV      BH,COLOR.B         ;Normal attribute.
XOR      CX,CX                      ;Top left corner.
MOV      DI,8*16 PTR COLUMNS
DEC      DL
MOV      DN,ROWS
MOV      AX,600H
PUSH     BP                          ;scroll active page.
INT      10H
POP      BP
RET

;-----;
DOE_CURSOR: MOV     DX,200H          ;Put cursor on screen in case
JMP      SHORT SET_CURSOR           ; of critical error like driv.
; drive door open.

HIDE_CURSOR: MOV     DX,ROWS        ;Retrieve CRT rows.
INC      DE                          ;Move one line below off screen.
XOR      DX,DL                      ;Column zero.

SET_CURSOR: PUSH     BX
XOR      BX,BH                      ;Page zero.
MOV      AH,2                      ;Set cursor position.
INT      10H
POP      BX
RET

;-----;
; INPUT: DI -> Valid scan codes table; CX = Length of table
; OUTPUT: AL=Scan code; AH=Char; CF=1 if Esc pressed.

DISPATCH: CALL     GET_KEY
PUSH     AX
CMP      AL,ESC_SCAN
STC
JE        DISPATCH_END
CMP      AH,CR
JE        DISPATCH_END
MOV      BX,CX
MOV      DX,DI
ADD      DX,CX
REPNE    SCASB
JE        GOT_DISPATCH
CALL     SEARCH
JMP      SHORT NO_DISPATCH

GOT_DISPATCH: SUB     BX,CX
DEC      BX
SHL      BX,1
ADD      BX,DX
MOV      AX,DIR_COUNT[BP]
DEC      ECX
MOV      CX,BAR_LINE[BP]
MOV      DX,LISTING_TOP[BP]
MOV      DI,DI
MOV      SI,LISTING_LEN
ADD      DI,SI
DEC      DI
CMP      DI,AX
JBE      DO_DISPATCH
MOV      DI,AX
CALL     [BX]
;Process the command.

DO_DISPATCH: CLC
NO_DISPATCH: POP      AX
DISPATCH_END: RET

;-----;
SEARCH:   PUSH     DS
OR        AL,AL
JE        NO_MATCH
CMP      AH,"a"
JB        DO_SEARCH
CMP      AH,"z"
JA        DO_SEARCH
AND      AH,5FH

DO_SEARCH: MOV      BL,AH
MOV      AX,SIZ TREE
MOV      CX,BAR_LINE[BP]
MUL      CX
MOV      SI,AX
MOV      DS,TREE_SEG[BP]
PUSH     SI
CALL     [BX]
CMP      BL,BYTE PTR [SI]
POP      SI

```

PRUNE.ASM

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```

NEXT_SEARCH:      JE      NEXT_SEARCH
                  JOR      SI,SI
                  JOR      CX,CX
NEXT_SEARCH:      INC     CX
                  CMP     CX,CS:DIR_COUNT[BP]
                  JAE     NO_MATCH
                  ADD     SI,SIZE_TREE
                  PUSH    SI
                  CALL    GET_NAME
                  CMP     BL,BYTE PTR [SI]
                  POP     SI
                  JNE     NEXT_SEARCH

                  POP     DS
MOV              BAR_LINE[BP],CX
MOV              AX,LISTING_TOP[BP]
MOV              BX,LISTING_LEN
CMP              CX,AX
JB              CENTER_BAR
ADD              AX,BX
DEC              AX
CMP              CX,AX
JBE              SEARCH_END

CENTER_BAR:      SHR      BX,1
                  SUB     CX,BX
                  JNC     NEW_TOP
                  ROR      CX,1
NEW_TOP:         MOV      LISTING_TOP[BP],CX
SEARCH_END:      CALL    DISPLAY_TREE
                  RET

NO_MATCH:        POP     DS

```

```

CALL    RET      BEEP
;-----;
GET_KEY:  MOV     AH,0                ;Wait for next keyboard input.
          INT     16H
          KCBG    AH,AL
          RET
;-----;
CK_KEY:   MOV     AH,1                ;is there a keystroke available.
          INT     16H
          RET
;-----;
CLEAR_IT: CALL     GET_KEY             ;Read keystrokes until buffer
CLEAR_KEY: CALL     CK_KEY             ; empty.
          JNE     CLEAR_IT
          RET
;-----;
WRITE_TTY: MOV     AH,5EH
          INT     19H
          RET
;-----;
DEFAULT_DIR1 = $
DEFAULT_DIR2 = DEFAULT_DIR1 + 65
DEST_SPEC    = DEFAULT_DIR2 + 65
LEVEL_ADDRESS = DEST_SPEC + 65 + 1
ZVEN
STACK_POINTER = $ + 100 + 500
;-----;
_TEXT      ENDS
          END      START

```

PRUNE.BAS

1 of 3

```

100 REM = BASIC PROGRAM TO CREATE PRUNE.COM
110 CLS:PRINT "Creating PRUNE.COM" *: OPEN "PRUNE.COM" * AS:1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM=0
130 FOR I = 1 TO 462
140 LINESUM=0: LOCATE 2,3: PRINT "Countdown: " 462 - I ;
150 FOR J = 1 TO 16: READ BYTE$: BYTE = VAL("4H" + BYTE$)
160 CHECKSUM = CHECKSUM + BYTE: LINESUM = LINESUM + BYTE
170 IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180 NEXT J
190 READ LINETOT$: LINECHECK = VAL("&H"+LINETOT$)
200 IF LINECHECK = LINESUM THEN GOTO 220
210 LOCATE 4,2: PRINT "Error in line " ; 260 + 10 * I: GOTO 260
220 NEXT I
230 CLOSE: READ FILETOT$ : FILECHECK = VAL(FILETOT$)
240 IF CHECKSUM = FILECHECK THEN GOTO 260
250 PRINT: PRINT "PRUNE.COM created successfully": SYSTEM
260 PRINT: PRINT "PRUNE.COM is not valid": END
270 DATA 09, 6E, 6, D, 20, 20, HE, D, A, 50, 52, 55, 4E, 45, 20, 31,
280 DATA 2E, 30, 20, 20, 63, 29, 30, 31, 39, 39, 30, 20, 5A, 69, 66, 66,
290 DATA 20, 43, 6F, 6D, 6D, 75, 6E, 69, 63, 61, 74, 69, 6F, 6E, 73, 20,
300 DATA 43, 6F, 2E, 20, D, A, 50, 43, 20, 4D, 61, 67, 61, 7A, 69, 6E,
310 DATA 45, 20, FE, 20, 4D, 69, 83, 60, 61, 65, 6C, 20, 4A, 2E, 20, 4D,
320 DATA 65, 66, 66, 6F, 72, 64, A, D, A, 51, 79, 6E, 74, 61, 70, 3A,
330 DATA 20, 20, 50, 52, 55, 4E, 45, 20, 50, 64, 3A, 5D, 20, 50, 44, 3A,
340 DATA 5D, D, A, A, 24, 1A, 71, 17, 31, 1F, 17, 31, 1F, 17,
350 DATA 70, 7, 70, F, F, 0, 43, 4F, 4D, 53, 50, 45, 43, 3D, 3E, 2F,
360 DATA 43, 20, 44, 52, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,
370 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, D, 64, 2F,
380 DATA 43, 20, 44, 49, 52, 4D, 41, 54, 43, 48, 20, 20, 20, 20, 20,
390 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,
400 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,
410 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,
420 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,
430 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,
440 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,
450 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, D, 0, 0, 0, 0,
460 DATA 0, 0, 0, 0, 0, 0, 0, 0, 3A, D, 0, 0, 0, 0, 0,
470 DATA BA, 3, 0, B0, 18, 0, 0, 5C, 20, 20, 52, 6F, 6F, 74, 29, 5C,
480 DATA 0, 2E, 2E, 0, 0, 3A, 5C, 2A, 2E, 2A, 0, 24, 24, 24, 24, 24,
490 DATA 24, 24, 24, 0, E5, 55, 6E, 4E, 61, 6D, 65, 64, 20, 20, 20,
500 DATA 20, 20, 44, 72, 69, 76, 65, 20, 0, 1A, 20, 20, 56, 6F, 6C, 75,
510 DATA 6D, 65, 20, 0, 08, 2, 94, 2, 0, 0, 0, 0, 0, 0, 0, 0,
520 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
530 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
540 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
550 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
560 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
570 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
580 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1D, 19, 1E, 0, 0,
590 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 70, 64, 69, 72, 65, 63, 74,
600 DATA 6F, 72, 69, 65, 73, 0, 20, 67, 79, 74, 65, 73, 20, 0, 74, 6F,
610 DATA 74, 61, 6C, 20, 31, 30, 30, 25, 0, 75, 73, 65, 64, 20, 20, 0,
620 DATA 66, 72, 65, 65, 20, 20, 0, 0, 0, 0, 0, 0, 0, 0, 0,
630 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
640 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
650 DATA 0, 0, 0, 48, 50, 49, 51, 47, 4F, 4B, 4D, 3B, 3C, 3D, 3E,
660 DATA 3F, 40, 41, 42, 43, 38, 13, 3D, 13, 5A, 13, 5C, 13, 6E, 13, 74,
670 DATA 13, 91, 13, 98, 13, A0, 13, A8, 9, BF, 9, 9A, 8, 63, 9, 4D,
680 DATA A, 46, A, C6, A, 3D, C, A6, 8, 46, 50, 49, 51, 47, 4F, F,
690 DATA 4B, 4D, 30, 13, 3D, 13, 5A, 13, 5C, 13, 6E, 13, 74, 13, 91, 13,
700 DATA 90, 13, A0, 13, 52, 65, 71, 75, 69, 72, 65, 73, 20, 32, 37, 3E,
710 DATA 40, 20, 66, 72, 65, 65, 20, 6D, 65, 6D, 6F, 72, 79, 24, 49, 6E,
720 DATA 76, 61, 6C, 69, 64, 20, 44, 72, 69, 76, 65, 24, D, A, 52, 65,
730 DATA 61, 64, 69, 6E, 67, 20, 44, 69, 72, 65, 61, 74, 6F, 72, 69, 65,
740 DATA 73, D, A, 24, 43, 61, 6E, 27, 74, 20, 78, 72, 75, 6E, 65, 2C,
750 DATA 20, 63, 6F, 70, 79, 20, 6F, 72, 20, 72, 65, 6E, 63, 6D, 65, 20,
760 DATA 72, 6F, 6F, 74, 20, 64, 69, 72, 65, 63, 74, 6F, 72, 79, 2E, 0,
770 DATA 49, 6C, 6C, 67, 67, 69, 83, 61, 6C, 20, 74, 6F, 20, 67, 72, 61,
780 DATA 66, 74, 20, 74, 6F, 20, 74, 60, 69, 73, 20, 64, 69, 72, 65, 63,
790 DATA 74, 6F, 72, 79, 2E, 0, 44, 69, 72, 65, 63, 74, 6F, 72, 79, 20,
800 DATA 6E, 61, 6D, 65, 20, 61, 6C, 72, 65, 61, 64, 79, 20, 65, 70, 69,
810 DATA 74, 73, 2E, 0, 53, 75, 62, 64, 69, 72, 65, 63, 74, 6F, 72, 79,

```

820	DATA	20,	63,	72,	65,	61,	74,	69,	6F,	6E,	20,	65,	72,	72,	6F,	72,	3B,	5FA
830	DATA	20,	63,	61,	6E,	27,	74,	20,	70,	72,	72,	6E,	65,	2E,	0,	4C,	6F,	500
840	DATA	67,	69,	63,	61,	6C,	20,	65,	72,	72,	6F,	72,	3B,	20,	43,	61,	6E,	5B7
850	DATA	27,	74,	20,	70,	72,	75,	6E,	65,	2E,	0,	20,	20,	50,	72,	65,	73,	4ED
860	DATA	73,	20,	61,	6E,	79,	20,	6B,	65,	79,	20,	74,	6F,	20,	63,	6F,	6E,	5A7
870	DATA	74,	69,	6E,	75,	65,	2E,	0,	48,	69,	67,	60,	6C,	69,	67,	60,	74,	5EB
880	DATA	20,	64,	65,	73,	74,	69,	6E,	61,	74,	69,	6F,	6E,	20,	64,	69,	72,	621
890	DATA	65,	63,	74,	6F,	72,	79,	20,	66,	6F,	72,	20,	62,	72,	61,	6E,	63,	623
900	DATA	68,	20,	61,	6E,	64,	20,	70,	72,	65,	73,	73,	20,	45,	6E,	74,	65,	5B4
910	DATA	72,	0,	50,	72,	75,	6E,	69,	6E,	67,	20,	69,	6E,	20,	70,	72,	6F,	5BD
920	DATA	67,	72,	65,	73,	73,	28,	2E,	2E,	0,	57,	41,	52,	4E,	49,	4E,	47,	4C4
930	DATA	3A,	20,	41,	6C,	6C,	20,	66,	69,	6C,	65,	73,	20,	69,	6E,	20,	60,	570
940	DATA	61,	72,	60,	65,	64,	20,	64,	69,	72,	20,	41,	4E,	44,	20,	69,	74,	556
950	DATA	27,	73,	20,	73,	75,	62,	64,	69,	72,	73,	20,	77,	69,	6C,	6C,	20,	5AE
960	DATA	62,	65,	20,	6C,	6F,	13,	74,	2E,	20,	20,	43,	6F,	6E,	74,	69,	6E,	582
970	DATA	75,	65,	3F,	20,	20,	59,	2F,	4E,	20,	0,	50,	72,	65,	73,	73,	20,	47C
980	DATA	45,	6E,	74,	65,	72,	20,	74,	6F,	20,	63,	6F,	6E,	66,	69,	72,	6D,	60F
990	DATA	20,	61,	6E,	64,	20,	73,	74,	61,	72,	74,	20,	64,	69,	72,	65,	63,	5C8
1000	DATA	74,	6F,	72,	79,	20,	62,	72,	61,	6E,	63,	68,	20,	72,	65,	6D,	6F,	62F
1010	DATA	76,	61,	6C,	2E,	20,	20,	45,	73,	63,	20,	74,	6F,	20,	63,	61,	6E,	521
1020	DATA	63,	65,	6C,	2E,	0,	61,	6E,	64,	20,	61,	6E,	79,	20,	73,	75,	62,	567
1030	DATA	64,	69,	72,	73,	20,	74,	6F,	20,	0,	52,	65,	6D,	6F,	76,	69,	6E,	5B5
1040	DATA	67,	20,	73,	75,	62,	64,	69,	72,	65,	63,	74,	6F,	72,	69,	65,	73,	66E
1050	DATA	20,	61,	6E,	64,	20,	66,	69,	6C,	65,	73,	2E,	2E,	2E,	0,	20,	66,	496
1060	DATA	69,	6C,	65,	73,	20,	20,	0,	20,	63,	6C,	75,	73,	74,	65,	72,	20,	52F
1070	DATA	62,	79,	74,	65,	73,	0,	52,	6F,	6F,	74,	20,	73,	69,	7A,	65,	20,	5C6
1080	DATA	69,	73,	20,	62,	79,	74,	65,	73,	20,	75,	73,	65,	64,	2E,	0,	45,	567
1090	DATA	6E,	74,	65,	72,	20,	6E,	65,	77,	20,	64,	72,	69,	76,	65,	20,	6C,	5E9
1100	DATA	65,	74,	74,	65,	72,	20,	20,	0,	44,	72,	69,	76,	65,	20,	64,	6F,	551
1110	DATA	65,	73,	20,	6E,	6F,	74,	20,	65,	70,	69,	73,	74,</					

PRUNE.BAS: This code creates PRUNE.COM when run once under BASIC.

Utilities

PRUNE BAS

2 of 3

1540	DATA	44,	2,	FE	CE	B2,	22,	EA,	6,	24,	BD,	DA,	BF,	BB,	1,	EB,	BD,	8BD	
1541	LATA	14,	3C,	1,	74,	57,	8B,	FC,	D,	74,	2C,	B6,	C4,	3C,	0,	74,	10,	557	
1542	DATA	3C,	20,	76,	EA,	B1,	FF,	CF,	1,	74,	EA,	AA,	EB,	B5,	14,	2B,	DE,	90B	
1543	DATA	B1,	FF,	BB,	1,	74,	D8,	EA,	AA,	14,	B8,	20,	EB,	A5,	14,	B8,	0,	857	
1544	DATA	EA,	AF,	14,	4F,	EB,	C8,	32,	C4,	AA,	EB,	B6,	13,	BF,	BB,	1,	EB,	8F1	
1545	DATA	16,	D4,	2,	BE,	9E,	C5,	2,	B4,	56,	CD,	21,	FE,	1F,	73,	5,	EB,	664	
1600	DATA	42,	11,	EB,	B,	C6,	6,	3E,	1,	1,	E9,	B1,	0,	EA,	EE,	10,	EB,	670	
1610	DATA	BF,	12,	C3,	C7,	6,	C1,	6,	C9,	6,	1E,	EA,	4,	72,	20,	3A,	C4,	73A	
1620	DATA	75,	6,	FE,	70,	6,	E9,	97,	0,	EA,	56,	3,	72,	3,	EB,	67,	7,	605	
1630	DATA	BC,	C8,	BE,	D8,	BE,	C0,	84,	3E,	14,	3,	5,	75,	FE,	C6,	6,	3F,	695	
1640	DATA	3,	0,	EB,	22,	A4,	B1,	F5,	2,	EB,	1,	A,	BC,	CB,	BE,	D8,	8F,	6E7	
1650	DATA	CF,	EB,	A9,	10,	EB,	4A,	12,	C3,	C7,	6,	C1,	6,	C3,	6,	EB,	A5,	852	
1660	DATA	4,	72,	5,	EB,	1B,	3,	EB,	57,	EB,	92,	20,	EB,	12,	C3,	EB,	88	882	
1670	DATA	B6,	B9,	2,	B,	C0,	75,	0,	BF,	F4,	3,	EA,	37,	9,	EB,	70,	EB,	7A3	
1680	DATA	10,	6,	EB,	36,	0,	EB,	44,	9,	EB,	19,	5,	EB,	6B,	12,	EB,	B3,	753	
1690	DATA	12,	EB,	E9,	13,	EB,	D7,	13,	3C,	15,	75,	54,	E9,	2F,	9,	EB,	6A,	729	
1700	DATA	5,	EB,	55,	12,	F0,	0,	13,	EB,	13,	13,	FB,	C1,	12,	EB,	FC,	D,	862	
1710	DATA	15,	3D,	BA,	9A,	FC,	6,	2,	FB,	46,	12,	EB,	E6,	12,	EB,	D8,	6,	OC,	73C
1720	DATA	CB,	BF,	EB,	FE,	CB,	AF,	3F,	3E,	3,	1,	75,	23,	C6,	6,	3E,	3,	671	
1730	DATA	2,	64,	EB,	03,	F3,	2,	EA,	97,	FE,	2,	3A,	96,	F6,	2,	74,	5,	71	71
1740	DATA	EA,	04,	9,	FB,	A4,	33,	ED,	EA,	7D,	9,	45,	54,	EB,	27,	10,	EB,	78	78
1750	DATA	B,	10,	EB,	AC,	11,	C3,	C6,	6,	3D,	3,	0,	EB,	5,	C6,	6,	3D,	588	588
1760	DATA	3,	1,	FE,	EB,	9F,	5,	3,	BB,	20,	0,	F7,	54,	BB,	2,	0B,	F0,	600	600
1770	DATA	B,	F6,	74,	5A,	56,	53,	EB,	7E,	7,	EB,	9F,	7,	5B,	5E,	EB,	9E,	752	752
1780	DATA	0,	1,	EB,	EA,	4,	BE,	EE,	4,	72,	47,	1F,	53,	EB,	9D,	0,	83,	674	674
1790	DATA	0,	22,	AE,	7B,	1,	A2,	EE,	2,	A3,	3,	3,	5E,	EB,	EB,	3,	765	765	765
1800	DATA	F,	BF,	F7,	5,	EB,	B2,	11,	B3,	C7,	13,	A1,	39,	3,	11,	DZ,	EB,	794	794
1810	DATA	E2,	E,	BF,	FE,	5,	EB,	A1,	11,	EB,	AA,	4,	EB,	2B,	11,	EB,	46,	879	879
1820	DATA	12,	EB,	19,	13,	EB,	7,	13,	EB,	93,	F,	EB,	14,	11,	C1,	BF,	6,	646	646
1830	DATA	6,	EB,	3A,	0,	1F,	C3,	EB,	29,	12,	EB,	0B,	10,	EB,	41,	0,	BE,	686	686
1840	DATA	14,	6,	FB,	74,	11,	BA,	36,	44,	2,	FE,	CE,	B2,	1B,	EB,	1F,	12,	647	647
1850	DATA	EB,																	

2720	DATA	8E,	C0,	E2,	79,	FE,	73,	1,	E,	0D,	0,	F0,	CF,	2,	BE,	2,	5,	81	
2720	DATA	E8,	F6,	B,	FE,	27,	1,	73,	3,	E9,	01,	0,	EB,	F2,	3,	72,	3,	72E	
2730	DATA	F8,	D7,	4,	72,	74,	C6,	6,	1E,	1,	1,	C4,	1E,	D4,	2,	26,	8B,	64	
2740	DATA	55,	27,	0B,	51,	2,	C7,	6,	61,	1,	2,	0,	E0,	9E,	1,	72,	62,	51E	
2750	DATA	26,	8B,	45,	1A,	A3,	CB,	2,	C5,	36,	DA,	2,	0B,	44,	27,	E,	1F,	57A	
2760	DATA	A3,	C0,	2,	26,	89,	45,	1A,	EA,	15,	5,	F0,	11,	2,	BD,	16,	CB,	5E9	
2770	DATA	2,	BB,	41,	3,	C7,	6,	61,	3,	0,	0,	E0,	6F,	1,	72,	2A,	EB,	619	
2780	DATA	16,	2,	76,	C6,	5,	F5,	EB,	F6,	4,	EB,	16,	CD,	2,	BD,	64,	2,	589	
2790	DATA	C7,	6,	61,	3,	1,	0,	EB,	53,	1,	72,	E,	BE,	41,	3,	B9,	20,	4C9	
2800	DATA	0,	F3,	A4,	EB,	D9,	4,	F8,	C3,	1E,	EB,	20,	4,	E,	1F,	0B,	1E,	78A	
2810	DATA	2,	C3,	BE,	BE,	4,	EB,	F5,	E,	1F,	EB,	30,	2,	BE,	CF,	5,	E8,	780	
2820	DATA	57,	B,	C6,	6,	1E,	3,	1,	2F,	C5,	16,	D4,	2,	E8,	E9,	9,	72,	5BB	
2830	DATA	78,	18,	D9,	0,	FB,	5,	0B,	D6,	15,	0,	1E,	56,	83,	C6,	2B,	78E		
2840	DATA	80,	7C,	1,	C4,	75,	8,	46,	4E,	EB,	FF,	72,	5D,	4E,	4E,	EB,	7F5		
2850	DATA	EF,	BC,	C0,	1,	EB,	D8,	BA,	57,	2,	89,	3,	0,	B4,	4E,	CD,	21,	7DA	
2860	DATA	23,	FB,	6,	84,	4F,	CD,	21,	72,	1B,	BA,	9E,	0,	FG,	6,	95,	0,	67B	
2870	DATA	3,	74,	9,	3F,	C9,	B8,	1,	43,	CD,	21,	72,	2E,	B4,	41,	CD,	21,	589	
2880	DATA	72,	2B,	EB,	0F,	BA,	51,	2,	EA,	7,	B,	5A,	1F,	B9,	17,	0,	B4,	569	
2890	DATA	4E,	CD,	21,	72,	17,	2E,	F0,	6,	45,	0,	2,	74,	7,	33,	C9,	B0,	590	
2900	DATA	1,	41,	CD,	21,	72,	1B,	BA,	CD,	21,	72,	2,	5A,	1F,	C1,	BA,	5B,	2,	64A
2910	DATA	B4,	19,	CD,	21,	72,	7,	B4,	3A,	CD,	21,	2B,	DE,	A,	BE,	64,	4,	72A	
2920	DATA	C3,	4E,	4E,	81,	F,	2B,	4A,	03,	EB,	1,	74,	A,	BB,	3C,	B1,	7,	73B	
2930	DATA	F2,	0B,	1C,	C3,	74,	ED,	C1,	1F,	EB,	47,	B,	2E,	BA,	9C,	F6,	2,	813	
2940	DATA	EF,	9C,	A,	2F,	C5,	16,	DA,	2,	EB,	20,	9,	BZ,	BF,	4,	72,	17,	68A	
2950	DATA	2E,	C3,	16,	D4,	2,	EB,	23,	0,	8B,	EB,	B9,	11,	0,	B4,	4E,	CD,	64B	
2960	DATA	21,	F5,	73,	7,	BE,	46,	4,	EB,	2,	FF,	F9,	1F,	C1,	B,	F6,	74,	7D1	
2970	DATA	5,	AC,	9B,	C4,	75,	F8,	C3,	1E,	EB,	BA,	8A,	2,	A3,	DB,	2,	B9,	874	
2980	DATA	2B,	0,	F7,	11,	0B,	FB,	89,	3E,	D4,	2,	8B,	8C,	C5,	2,	A3,	D6,	803	
2990	DATA	2,	BE,	18,	C4,	5,	1A,	1F,	EB,	29,	6,	C3,	1E,	C5,	3F,	D4,	2,	61D	
3000	DATA	32,	C0,	0,	1E,	75,	2,	0B,	5C,	EB,	5,	1F,	C3,	A1,	C9,	2,	8E,	64C	
3010	DATA	C0,	B,	D2,	74,	14,	89,	16,	AB,	2,	BB,	C2,	4B,	4B,	8A,	E,	EA,	6ED	
3020	DATA	2,	12,	EB,	F7,	E1,	3,	6,	D0,	2,	BB,	D2,	0,	89,	16,	EB,	2		

1890	DATA	55,	2E,	B,	36,	A4,	2,	B8,	D,	3B,	F2,	74,	13,	26,	C6,	42,	1	636	
1891	DATA	C3,	B3,	C6,	2B,	3B,	F2,	74,	7,	26,	C6,	42,	1,	B3,	EB,	F2,	7E,	70C	
1900	DATA	B9,	36,	AA,	2,	5E,	2E,	FF,	6,	A2,	2,	3,	FD,	47,	B8,	CB,	AA,	78D	
1910	DATA	B8,	CA,	AA,	B3,	C6,	5,	B9,	8,	0,	EB,	5E,	B,	B8,	3C,	2B,	74,	6C3	
1920	DATA	9,	B8,	2E,	AA,	B9,	3,	0,	EB,	5E,	0,	5E,	47,	B8,	44,	12,	AA,	5B5	
1930	DATA	5F,	B8,	44,	18,	24,	B9,	45,	27,	2E,	A1,	3F,	3,	24,	B9,	45,	29,	487	
1940	DATA	B3,	C7,	B8,	2E,	FF,	16,	AA,	2,	2E,	B9,	3E,	AA,	2,	45,	45,	2B,	633	
1950	DATA	B8,	9E,	A4,	1E,	FF,	7,	3E,	3E,	3E,	7,	0,	FF,	2,	74,	0,	3,	633	
1960	DATA	4A,	75,	53,	5E,	B8,	FB,	1E,	EB,	71,	FF,	5E,	5B,	C3,	C3,	14,	755		
1970	DATA	EB,	E2,	2E,	B9,	6,	AA,	2,	5D,	5E,	C3,	AC,	3C,	2B,	74,	1,	AA,	621	
1980	DATA	E2,	F8,	C3,	EB,	C1,	1,	1F,	55,	B8,	B6,	B4,	2,	B9,	2B,	0,	F7,	853	
1990	DATA	E1,	B8,	F0,	B8,	2,	0,	EB,	C6,	3,	B8,	B6,	B4,	2,	0A,	3E,	BE,	823	
0000	DATA	2,	B8,	E,	45,	7,	3B,	2E,	BC,	2,	BE,	9E,	C5,	2,	2E,	B8,	AE,	543	
0010	DATA	B8,	2,	74,	3,	FF,	FF,	51,	52,	56,	57,	0,	FF,	2,	0,	3B,	75,	543	
0020	DATA	75,	2D,	74,	AC,	74,	AC,	74,	AC,	74,	AC,	74,	AC,	74,	AC,	74,	AC,	543	
0030	DATA	2B,	BA,	3E,	7B,	AC,	AC,	AC,	CB,	74,	7,	EB,	B9,	3,	E2,	FE,	EB,	749	
0040	DATA	14,	2E,	BA,	3E,	7B,	AC,	2,	4E,	AC,	EB,	BD,	1,	E2,	FA,	EB,	6,	AC,	285
0050	DATA	EB,	B5,	3,	E2,	FA,	5F,	7E,	3,	3E,	3C,	2,	5E,	B3,	C6,	2B,	5A,	0A4	
0060	DATA	42,	59,	B8,	C3,	5D,	1F,	C3,	EB,	3D,	1,	BA,	B6,	F6,	2,	4,	41,	E2,	58E
0070	DATA	A2,	78,	2,	B8,	1,	0,	EB,	46,	3,	BA,	3E,	BE,	2,	BE,	7B,	2,	5BE	543
0080	DATA	EB,	76,	3,	EB,	BA,	4,	2,	EB,	6F,	3,	BA,	44,	2,	2C,	5,	32,	5BE	543
0090	DATA	E4,	E2,	B3,	C6,	2B,	74,	C3,	27,	0,	EB,	5E,	0,	EB,	5E,	0,	EB,	7CB	543
0100	DATA	9,	0,	EB,	54,	3,	5F,	3,	3E,	3C,	2,	57,	0B,	06,	1,	3,	F7,	48E	543
0110	DATA	A6,	5,	3,	EB,	BE,	8,	BE,	16,	3,	EB,	3D,	3,	BE,	1E,	3,	EB,	52A	543
0120	DATA	37,	3,	5F,	3,	3E,	3C,	2,	57,	0B,	06,	1,	3,	2B,	B6,	FD,	2,	4,	603
0130	DATA	EB,	F7,	A6,	5,	3,	EB,	6C,	0,	BE,	3,	EB,	1B,	3,	BE,	29,	603	543	
0140	DATA	3,	EB,	15,	3,	5B,	EB,	2A,	8,	5F,	3,	3E,	3C,	2,	0B,	4A,	5,	46D	543
0150	DATA	77,	A6,	FD,	2,	EB,	4C,	0,	BE,	16,	3,	EB,	3D,	3,	BE,	29,	603	543	
0160	DATA	77,	A6,	FD,	2,	EB,	4C,	0,	BE,	16,	3,	EB,	3D,	3,	BE,	29,	603	543	
0170	DATA	FE,	C3,	55,	BE,	64,	0,	F7,	E6,	AB,	AE,	1,	3,	F7,	F5,	D1,	E2,	9B4	543
0180	DATA	42,	2B,	EA,	15,	8,	0,	3D,	64,	8,	75,	0,	EB,	24,	3,	EB,	CB,	51F	

4359	DATA	B6,	B8,	JF,	B6,	B4,	2,	7,	DF,	FF,	B6,	B4,	2,	EB,	D9,	7,	017
4480	DATA	B6,	EB,	23,	FF,	B5,	1,	32,	CF,	EB,	2C,	FF,	B4,	2E,	44,	2,	089
4418	DATA	ED,	5,	B0,	3,	EB,	28,	FF,	C3,	5E,	1E,	BC,	CB,	8E,	D0,	B4,	066
4428	DATA	2,	EB,	6D,	1,	1F,	B,	76,	74,	17,	EB,	E1,	F6,	33,	C9,	56,	41
4438	DATA	EB,	8E,	F6,	B3,	FE,	1,	77,	F6,	5A,	EB,	55,	1,	72,	6,	E2,	P6
4440	DATA	F8,	5E,	C3,	5A,	E2,	FF,	9F,	5E,	C3,	8A,	D9,	08,	E2,	5F,	08,	EA
4441	DATA	F1,	89,	3C,	3A,	35,	18,	9F,	C1,	78,	77,	A,	4E,	8E,	BE,	19,	53
4469	DATA	2,	B6,	8E,	EB,	2A,	1,	CB,	C,	8E,	9F,	F2,	7,	8E,	C3,	85,	85
4470	DATA	21,	B0,	56,	FF,	2,	EB,	19,	1,	C3,	6,	B0,	0,	5,	CD,	18,	65A
4480	DATA	40,	8E,	CB,	26,	A1,	4A,	0,	A3,	3A,	2,	D1,	EB,	A3,	3C,	2,	169
4498	DATA	26,	A1,	4E,	0,	A3,	3E,	2,	26,	A1,	63,	0,	5,	6,	B9,	0,	386
4503	DATA	B8,	3D,	BA,	3,	74,	4,	B1,	C1,	0,	8,	A3,	40,	2,	09,	E,	42
4518	DATA	2,	BE,	B8,	1,	26,	A9,	49,	0,	3C,	7,	74,	18,	3C,	2,	74,	C
4522	DATA	EB,	7B,	1,	3C,	3,	74,	5,	B0,	3,	0,	CD,	18,	32,	FF,	02,	18
4540	DATA	3C,	1C,	C,	18,	8E,	16,	42,	8E,	16,	42,	8E,	16,	42,	8E,	16,	42
4540	DATA	45,	2,	7,	BF,	76,	1,	09,	5,	F3,	A4,	1,	8E,	3E,	1,	B8,	35
4550	DATA	B5,	1,	74,	D,	8A,	1E,	77,	1,	89,	E3,	7,	12,	FF,	B4,	0,	582
4560	DATA	CD,	10,	13,	CF,	EB,	45,	0,	47,	47,	BE,	9,	1,	8A,	3E,	76,	1
4570	DATA	EB,	6E,	0,	B0,	FE,	EB,	40,	0,	B0,	20,	EB,	3B,	0,	46,	EB,	5B
4580	DATA	0,	A9,	44,	2,	FE,	CB,	32,	E4,	EB,	22,	0,	BE,	CF,	0,	57,	0A
4590	DATA	3E,	74,	1,	EB,	0,	5F,	3,	1E,	3C,	2,	EB,	3B,	0,	C3,	EB,	58C
4600	DATA	2,	B,	6,	1E,	74,	3,	3E,	3C,	2,	47,	47,	7B,	76,	76,	76,	C
4610	DATA	2,	1,	6,	1E,	74,	3,	3E,	3C,	2,	47,	47,	7B,	76,	76,	76,	C
4620	DATA	16,	49,	2,	BA,	DB,	EC,	D9,	D2,	72,	FB,	FA,	EC,	D0,	D8,	73,	PB
4630	DATA	8B,	C3,	AB,	FB,	7,	C3,	EB,	DF,	FF,	AC,	3C,	D,	77,	FB,	C3,	B4
4640	DATA	E,	CD,	21,	C3,	C6,	4,	5C,	46,	52,	FE,	C2,	B4,	47,	CD,	21,	5A
4650	DATA	C3,	B4,	3D,	21,	C3,	B4,	9,	CD,	21,	C3,	1E,	E,	1F,	53,	EB,	757
4660	DATA	0,	8A,	9E,	76,	2,	FE,	C2,	B4,	36,	1,	CD,	21,	3D,	FF,	FF,	964
4670	DATA	8E,	5A,	7F,	C3,	FD,	2,	BE,	9E,	5,	3,	1F,	53,	EB,	757	EB,	964
4680	DATA	F8,	55,	7F,	C3,	BD,	1E,	4,	BA,	17,	EB,	33,	C,	77,	C3,	08,	06
4690	DATA	EB,	24,	0,	B0,	B4,	EB,	43,	EB,	0,	8D,	C3,	E6,	42,	EB,	0,	0A
4700	DATA	C4,	E6,	42,	E4,	61,	C,	3,	EB,	0,	E6,	61,	EB,	9,	0,	E4,	61
4710	DATA	24,	FC,	EB,	0,	E6,	61,	C3,	1E,	B8,	0,	8E,	D0,	A1,	6C,	0,	79E
4720	DATA	8B,	16,	6C,													

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Michael J. Mefford

PRUNE Command

June 26, 1990 (Utilities)

Purpose:

To organize a hard disk by renaming, removing, copying, and moving entire directories together with their files and subdirectories. Directories may be put into other locations on their current or on another drive's directory tree. PRUNE also reports directory or branch size and permits directly calling up *PC Magazine's* DR (August 1987) and DIRMATCH (September 26, 1989) utilities to inspect files or update directories with current file versions.

Format:

PRUNE [d:] [d:]

Remarks:

Entered at the DOS prompt without either of its two optional (d:) drive arguments, PRUNE displays a graphic directory tree of the current drive in both of its side-by-side windows. The d: arguments permit initial display of any one or two directory trees on the system. The active window, which has the highlight bar, can be toggled with the Tab key or with the Left or Right Arrow keys. The directory tree can be traversed with the Up Arrow, Down Arrow, PgUp, PgDn, Home, and End keys. Esc exits the utility.

The operations PRUNE can perform on the highlighted directory are executed with the Function Keys. Note that except for the Rename Directory command (F3), the word *directory* here includes all directory and subdirectory files. Prompts and confirmatory warnings are provided as needed.

F1 copies the highlighted directory to another location on the current tree or to one highlighted in the alternate window. F2 removes a directory and should be used with special care. F4 moves a directory (it copies, then removes the original). F5 gives the size of a directory branch, including subdirectories, in terms of the bytes allocated to the clusters required. Although PRUNE will not copy or move directories where insufficient space exists, this information may be useful in deciding which directories to work on. F6 displays the same information for a directory's files without including subdirectory files. F7 permits loading and displaying the tree of a new drive. F8 calls up the DR utility to permit reading the files in a directory, and F9 calls up DIRMATCH to permit updating a target directory with file versions from a more recent directory. Note that for F8 and F9 to work, these utilities must be on the DOS path. If a floppy disk drive is used, COMMAND.COM must also be on it.

Instructions on modifying PRUNE.COM to call a utility other than DR or to change its color scheme are given in the sidebar "Customizing PRUNE."

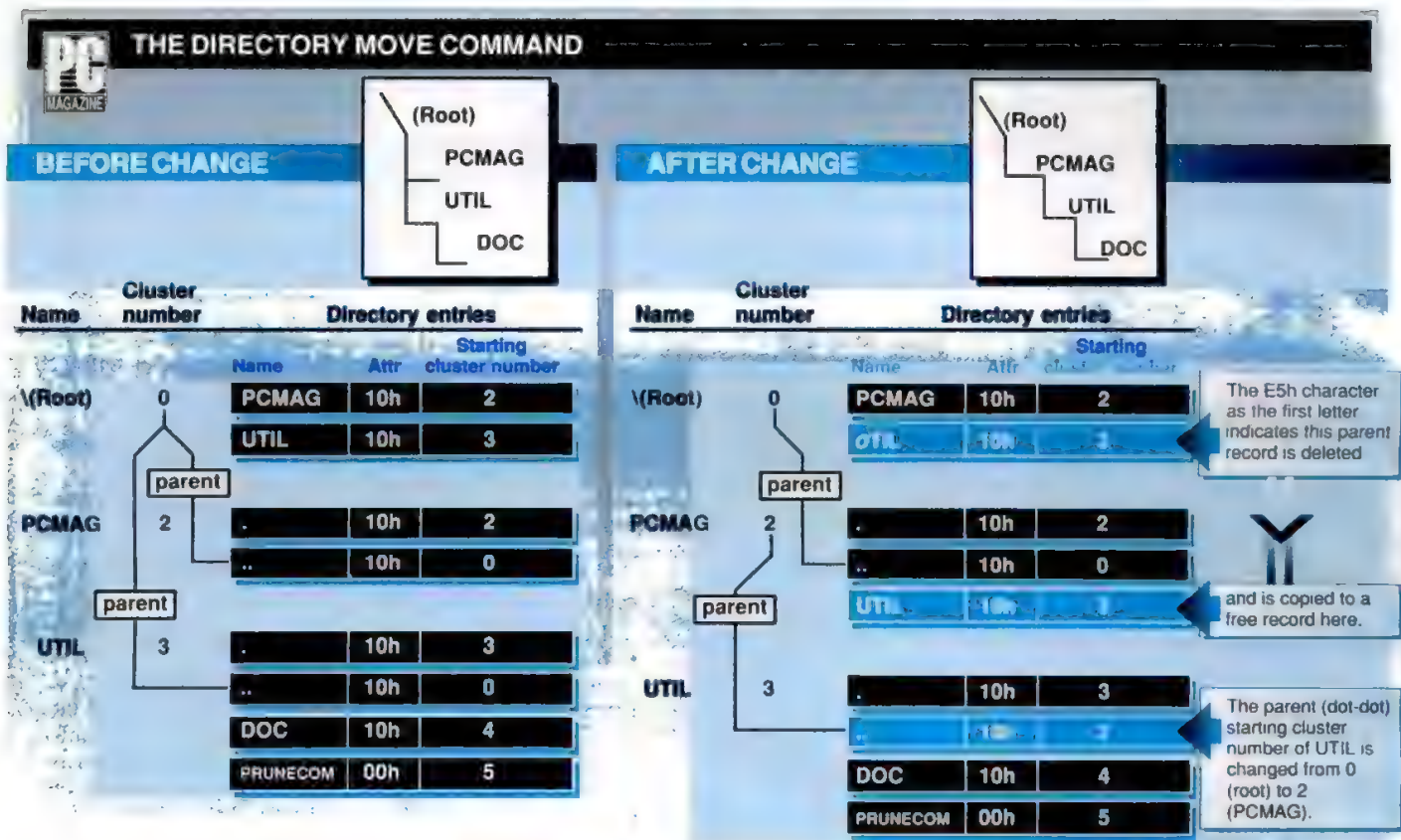


Figure 2: When moving directories and their files within the same disk partition, PRUNE manipulates the "double-dot" directory entries rather than physically copying the data. As a result, you can move hundreds of files in the blink of an eye.

space on-disk one cluster at a time. On a typical hard disk, a cluster has 2K, or 2,048 bytes. (Older 10MB hard disks use 8K clusters.) Directory entries are 32 bytes in size, which means that a one-cluster directory has room for 64 entries. If a directory's dot, dot-dot, and file entries add up to 64, the directory cluster will be full, and there will be no empty place for the moved record.

To avoid this situation, PRUNE creates a temporary subdirectory, with the name \$\$\$\$\$\$, in the destination directory. This temporary subdirectory is then immediately removed with standard DOS interrupt 21 calls. If the directory was full, DOS will allocate another cluster to the directory to hold the \$\$\$\$\$\$ entry. Since the temporary directory is immediately deleted, PRUNE will always be able to find a deleted record (the \$\$\$\$\$\$ entry) whose first character is E5h. The deleted record will be all by itself in a newly allocated cluster chained to the previous one.

But if you create a subdirectory that re-

sults in allocating a new cluster, won't deleting that subdirectory return that cluster back to the disk pool? After all, that specific cluster will be empty and completely unused. In a sense, directories are just files, and if reducing a file in size frees clusters, those clusters are returned to the disk pool.

In another sense, however, directories are not just files. Once a cluster is allocated to a directory, it is never deallocated as long as the owner of the directory exists. Probably the reason DOS does not deallocate freed directory clusters is that directory entries are not necessarily contiguous, like a file's data. When a directory entry is deleted, the freed space is not consolidated by moving the other records down; the deleted record remains where it is, with only the E5h character to indicate that it is not in use.

Why doesn't DOS consolidate the records? Suppose a directory is large enough that three clusters are allocated to it. Now suppose you delete half the entries that occupy the middle cluster and half the entries

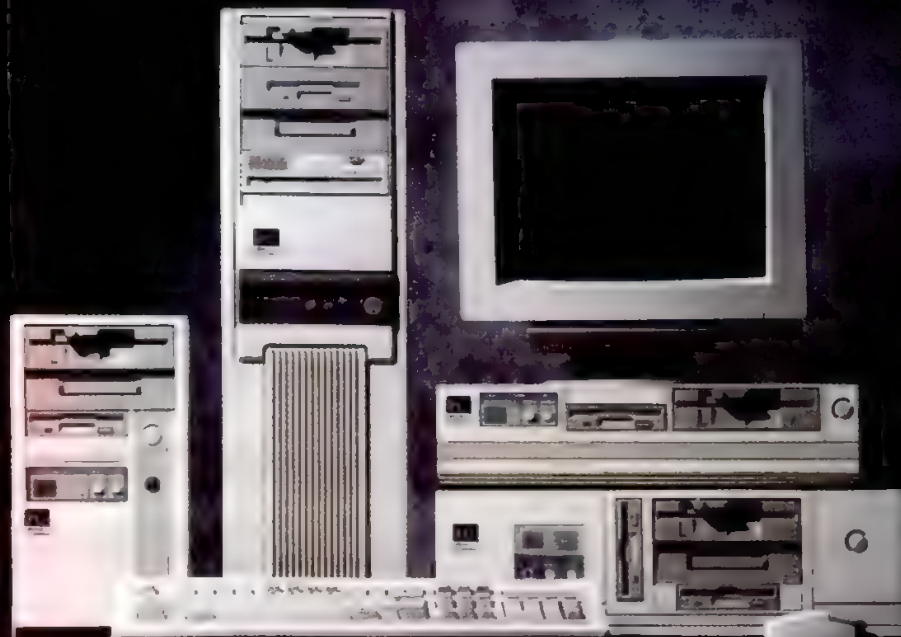
in the last cluster. A cluster could be freed if the active entries in the third were moved into the erased slots of the second and the third cluster were then unlinked. However, this consolidation process would slow response time and the gain in the few extra reclaimed clusters would not be worth it.

What this all means is that if you have a directory with a lot of files, deleting those files will free the clusters used by the files themselves, but not the clusters used by the directory. The only way to do that is to RD the directory and then re-create it.

IN CLOSING

As a directory specialist, PRUNE will serve as a useful complement to the PC Magazine file management swat team of RN, DR, and CO. PRUNE's own functionality, coupled with its integration of DR and DIRMATCH, gives you all the power you need to keep your directory system up to date. And now you won't have any excuse to keep putting off the organizational task you know is long overdue. ■

Michael J. Mefford is a contributing editor of PC Magazine.



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Standard System Features:*

- 80286-12, 80286-16, 80286-20 operating at 12 MHz, 16MHz, or 20MHz w/Zero Wait
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- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability
- 1:1 Interleaved Hard/Floppy Drive Controller, 1Mb/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1 Parallel ports on std-configurations
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS w/full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0EMS hardware
- User configurable I/O timing permitting compatible operation w/older peripherals or faster I/O for newer devices
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- Medium foot print case w/6 Disk Drive bays

Options:

- Low profile Slim Line Case w/3 Disk bays (as pictured above)
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- VGA or CGA Plasma Portable Case
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice

PC BRAND 286/12

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives Mb/Ms	20/40	40/19	66/25	100/25
No Video	\$929	\$1029	\$1209	\$1349
Mono	\$1049	\$1149	\$1329	\$1469
VGA-Mono	\$1229	\$1329	\$1509	\$1649
VGA-Color	\$1459	\$1559	\$1739	\$1879
SVGA/Color	\$1569	\$1669	\$1849	\$1989

PC BRAND 286/16

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives Mb/Ms	20/40	40/19	66/25	100/25
No Video	\$1079	\$1179	\$1359	\$1499
Mono	\$1199	\$1299	\$1479	\$1619
VGA-Mono	\$1379	\$1479	\$1659	\$1799
VGA-Color	\$1609	\$1709	\$1889	\$2029
SVGA/Color	\$1719	\$1819	\$1999	\$2139

PC BRAND 286/20

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives Mb/Ms	20/40	40/19	66/25	100/25
No Video	\$1229	\$1329	\$1509	\$1649
Mono	\$1349	\$1449	\$1629	\$1769
VGA-Mono	\$1529	\$1629	\$1809	\$1949
VGA-Color	\$1759	\$1859	\$2039	\$2179
SVGA/Color	\$1869	\$1969	\$2149	\$2289

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*Features below for 286/16 and 20 only. Call for 286/12



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*-Personal Computing,
Best Bargain Systems, Dec, 1989*

"The PC Brand 386 SX-16
performed at least as well as
the far costlier Compaq...
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computing"

*-Computer Buyer's Guide,
Cover Story, Oct, 1989*

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16 MHz Clock, Zero Wait Operation • Norton SI 18.7 Landmark™ 18.3MHz.
512K RAM, 1 2MB or 1.44MB Drive, 101-Key Keyboard, 2 Serial and 1 Parallel Ports

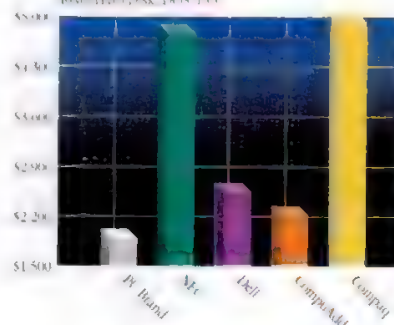
Standard System Features:

- 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB RAM
- 1 2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability
- 1:1 Interleaved Hard/Floppy Drive controllers, 1 Mb Second disk transfer rates on all 100 Mb drives or larger
- Enhanced 101-key Click Tactile Keyboard
- 2 Serial & 1 Parallel ports on std-configurations
- High Capacity 200 Watt System Power Supply
- Real Time Clock Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS-DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/ 6 Disk Drive bays (Shown in optional Mini Size Tower * Case)

Options:

- Low profile Slim Line Case w/3 Disk bays
- Mini Size desk top Tower * Case w/4 Disk Drive bays (as pictured above)
- VGA or CGA Plasma Portable Case
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice

80386SX 16MHz System w/ 1MB RAM, VGA Card, Color Monitor, 10MB Hard Disk, DOS 3.3



PC BRAND 386SX-16

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives:	20/40	40/19	66/25	100/25
No Video	\$1229	\$1329	\$1509	\$1649
Mono	\$1349	\$1449	\$1629	\$1769
VGA-Mono	\$1529	\$1629	\$1809	\$1949
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-Computer Shopper, Cover Story
November, 1988

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-PC Magazine, 25MHz 386 PC's, Feb. 14, 1989

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2 Serial and 1 Parallel Ports

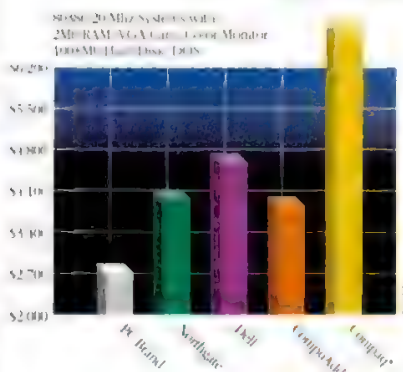
PC BRAND 386/25 _____ \$1499

25 MHz Clock, Zero Wait Operation
Norton SI 28.2 Landmark Speed 33.6MHz
Norton SI 31.6 Landmark Speed 43.5 w/Cache
1024K RAM, 1.2MB or 1.44MB Drive, 101-Key-board
2 Serial and 1 Parallel Ports

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"and the company backs it all with what may be the longest warranty on the market...PC Brand makes it possible to buy two complete systems for less than most competitors charge for just one."

- PC Magazine, 25MHz 386 PC's
February 14, 1989



Standard System Features:

- True 20MHz or 25MHzZ Intel 80386 CPU Operating with Zero Wait States
- 1024K RAM standard expandable to 16MB using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A". Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability
- 1:1 Interleaving Hard Drive/Floppy Drive controllers, 1Mb. Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 serial & 1 parallel ports on std-configurations
- High Capacity 200Watt System Power Supply
- Real Time Clock Calendar with 5 Year Battery
- 80287, 80387, or Weitek Co-Processor Support
- AMI BIOS with full MS-DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/6 Disk Drive bays

Options:

- Low profile Slim-Line Case w/3 Disk bays
 - Full Size Tower * Case w/8 Disk Drive bays
 - Mini Size Tower * Case w/4 Disk Drive bays
 - VGA or CGA Plasma Portable Case
 - Custom configurations w/Name Brand peripherals of your choice
- (Shown in Medium foot print Desktop Case)

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with Hard Disk Drive, Monitor & Video Card

Hard Drives:	40/19	66/25	100/25	200/19
No Video	\$1779	\$1959	\$2099	\$2549
Mono	\$1899	\$2079	\$2219	\$2669
VGA Mono	\$2079	\$2259	\$2399	\$2849
VGA Color	\$2409	\$2489	\$2629	\$3079
SVGA/Color	\$2419	\$2599	\$2739	\$3189

PC BRAND 386/25

with Hard Disk Drive, Monitor & Video Card

Hard Drives:	40/19	66/25	100/25	200/19
No Video	\$1929	\$2109	\$2249	\$2699
Mono	\$2049	\$2229	\$2369	\$2819
VGA Mono	\$2229	\$2409	\$2549	\$2999
VGA Color	\$2459	\$2639	\$2779	\$3229
SVGA/Color	\$2569	\$2749	\$2889	\$3339

CIRCLE 309 ON READER SERVICE CARD

"PC BRAND 386/33 HAS FLAWLESS COMPATIBILITY, LOWEST PRICE"

InfoWorld, Product Review,
January 8, 1990

FROM \$2299

InfoWorld 386/33 Review Scores:

PC Brand _____ 8.0

Compaq _____ 7.1



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quality for low price either.
The PC Brand machines
are an efficient combi-
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off-the-shelf Parts."

-PC Magazine, 33MHz 386 PC's,
October 31, 1989

"...great value. Period.
...excellent price perform-
ance ratio; high quality."

-Computer Buyers Guide,
Product Review,
February, 1990

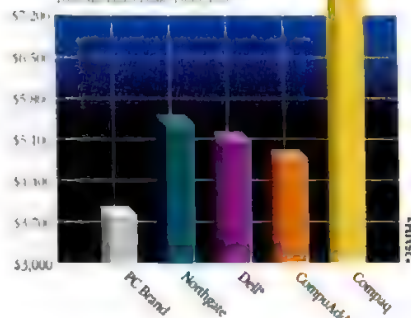
Standard System Features:

- True 33 MHz INTEL 80386-33 CPU operating w/Zero Wait States Delivering up to 58.7 MHz Effective Throughput
- Intel 82385-33 Cache Processor with 32K 25NS Static RAM Standard
- 1024K RAM Standard Expandable to 16MB
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive/Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports-2 serial, 1 parallel
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- Phoenix BIOS with Full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- EMS and Disk Cache in ROM
- 8 Slot motherboard design
- Medium foot print case w/6 Disk Drive bays

Options:

- Full size Tower® Case w/8 Disk Drive bays (as pictured above)
- Custom configurations w/Name Brand peripherals of your choice
- Factory Installed Ram Upgrades

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Hard Drives: Mb/Mo	40/15	66/25	100/25	200/15
No Video	\$2679	\$2859	\$2999	\$3449
Mono	\$2799	\$2979	\$3119	\$3569
VGA-Mono	\$2979	\$3159	\$3299	\$3749
VGA-Color	\$3209	\$3389	\$3529	\$3979
SVGA/Color	\$3319	\$3499	\$3639	\$4089

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Unlike the conventional 'Clone' cases found in the market, our Standard full sized desk top case is the first of an entirely new generation. This case fully integrates the lessons learned in the last 5 years of PC history. Full 8 slot I/O, 6 Drive bays and a 200 Watt PS/2 style compact Power Supply result in maximum configurability across our full line of system/drive and video applications, where a desk top placement is desired.

Mini Tower*

Where your application requires more drives or I/O slot configurability than offered with our Slim Line case, but small footprint, attractive design and desk top placement are still required, our Mini Tower* Case is the solution.

Server/Multi-User Tower*

Our Server/Multi-User Tower* case has been designed for Local Area Network and other Multi Terminal applications which typically call for massive Disk storage, maximum I/O card slot usage, high total system power consumption and enhanced operational security. It's larger size, cable routing facilities, enhanced power supply, extra cooling and push button security features have all been optimized around the needs of these systems.

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Rack mount and other custom enclosures can be configured to your specifications by our special bid desk.

Server/Multi-User Tower*

Physical Specifications

Dimensions:

7.5"W x 25.5"H x 17.9"D

Construction: 1.4mm Heavy Gauge Zinc Plated Steel, Slide-In Top

Weight: 47.3 Lbs

Functional Specifications

I/O Slots: 8 total featuring:
8 full length 16-bit or 8-bit

Drive Support: 6 total disk or tape drives mounted as follows:
4 Exposed 5.25" 1/2 Height
2 Internal 5.25" 1/2 Height
(all bays can be used for 3.5" drives also.)

System Power: 220 Watt U/L Heavy Duty

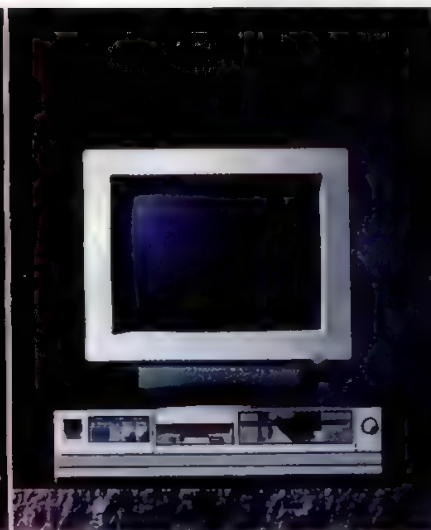
Indicators: Turbo Speed Numeric Indicator, Hard Disk, Activity LED, Power On LED

Switches: Power On on front of case, Turbo Speed Change Push Button, System Reset Push Button, Keyboard Key Lock

Special Push button cover to protect against accidental activation of either turbo or reset buttons.



*Tower is a registered trademark of NCR corporation



Slim Line

Physical Specifications

Dimensions: 17.1"W x 4.25"H x 16.8"D

Construction: 1.2mm Heavy Gauge Zinc Plated Steel, Slide-In Top

Weight: 26.5 Lbs

Functional Specifications

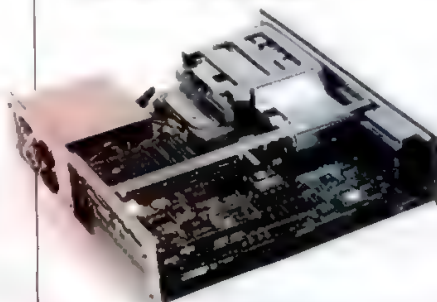
I/O Slots: 5 total mounted on 90 degree rotated adapter tree inserted into main system board 16-bit slot featuring
2 full length 16-bit
1 half length 16-bit
2 half length 8-bit

Drive Support: 3 total disk or tape drives mounted as follows
1 Exposed 5.25" 1/2 Height
1 Internal 5.25" 1/2 Height
1 Exposed 3.5" 1/2 Height

System Power: 200 Watt U/L PS/2 Style

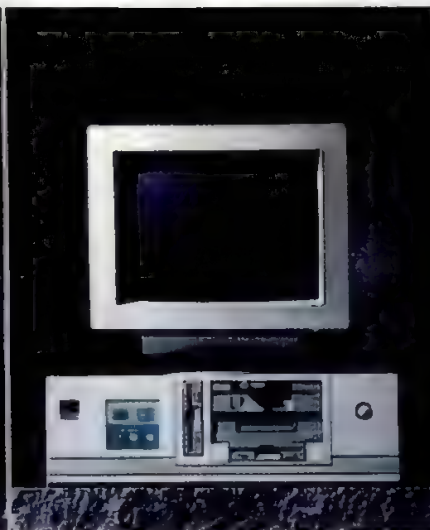
Indicators: Turbo Speed LED, Hard Disk, Activity LED, Power On LED

Switches: Power On on front of case, Turbo Speed Change Push Button, System Reset Push Button



All photographs above feature PC Brand 386 Series motherboards configured with maximum options to demonstrate the capabilities of each specific case

Certain I/O, drive, and power cables have been removed to improve visibility of components



Desk Top

Physical Specifications

Dimensions: 18.9"W x 6.5"H x 15.9"D

Construction: 1.4mm Heavy Gauge Zinc Plated Steel, Slide-In Top

Weight: 40.5 Lbs

Functional Specifications

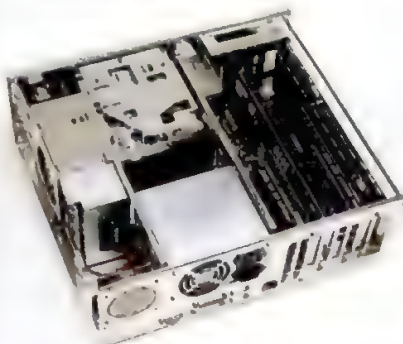
I/O Slots: 8 total featuring
8 full length 16-bit or 8-bit

Drive Support: 6 total disk or tape drives mounted as follows
2 Exposed 5.25" 1/2 Height
2 Exposed 3.5" 1/2 Height
2 Internal 5.25" 1/2 Height

System Power: 200 Watt U/L PS/2 Style

Indicators: Turbo Speed LED, Hard Disk, Activity LED, Power On LED

Switches: Power On on front of case, Turbo Speed Change Push Button, System Reset Push Button, Keyboard Key Lock



Mini Tower

Physical Specifications

Dimensions: 7"W x 12.9"H x 15.9"D

Construction: 1.2mm Heavy Gauge Zinc Plated Steel, Slide-In Top

Weight: 25.6 Lbs

Functional Specifications

I/O Slots: 7 total featuring
7 full length 16-bit or 8-bit 1 half length 16-bit or 8-bit

Drive Support: 4 total disk or tape drives mounted as follows
2 Exposed 5.25" 1/2 Height
2 Exposed 3.5" 1/2 Height

System Power: 200 Watt U/L PS/2 Style

Indicators: Turbo Speed Numeric Indicator, Hard Disk, Activity LED, Power On LED

Switches: Power On on front of case, Turbo Speed Change Push Button, System, Reset Push Button, Keyboard Key Lock



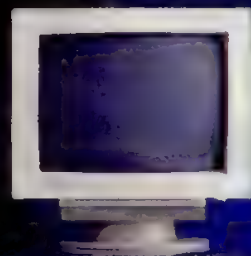
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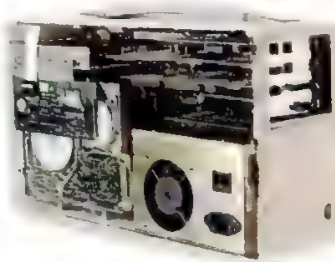
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by
Charles Petzold

Environments

This column deals with *graphics segments*, whose very name raises an immediate problem. If you're like me, you've spent so much time programming for Intel microprocessors that the word *segment* means one thing and one thing only: a block of memory addressable by a segment address and an offset address.

Put that definition aside for this column. A graphics segment has nothing to do with segmented memory. Nor did IBM and Microsoft invent terminology simply to confuse us! The word *segment* is a traditional one in graphics programming; segments show up in other graphics systems, such as GKS (Graphical Kernel System) and Macintosh QuickDraw (where they are known as *pictures*).

Although *Microsoft Windows* does not support segments, the Graphics Programming Interface (GPI) of the OS/2 Presentation Manager does. In fact, the support of segments in GPI involves so many functions that the functions actually become more important than the segments. As I'll discuss shortly, most Presentation Manager programs can safely ignore segments.

There is one aspect of segments, however, that is genuinely useful in Presentation Manager programs: segments provide a convenient and structured way for PM programs to draw in a second thread of execution.

WHAT IS A SEGMENT?

A *graphics segment* is a collection of graphics primitives encoded in a binary form. A *graphics primitive* is either a drawing function (such as the GPI functions *GpiLine*, *GpiBox*, and *GpiPolySpline*) or a function that sets a drawing attribute (such as *GpiSetColor* and *GpiSetMix*).

A segment is identified by a 32-bit long integer, which is usually called the segment *name* or the segment *ID*. An OS/2 Presentation Manager program can *open* a segment by calling the *GpiOpenSegment* function. If the segment does not already exist, it will be created. Thereafter, any

Programming for Multithreaded Drawing, Part 3

■ Using graphic segments and the *GpiSetStopDraw* function provides an elegant approach to multithreaded drawing.

GPI drawing functions and attribute functions that the program calls will become part of the segment. The segment is *closed* by a call to *GpiCloseSegment*. Any code that begins with *GpiOpenSegment* and ends with *GpiCloseSegment* is known as a *segment bracket*.

Your program can then draw the contents of the segment on the device associated with the presentation space by calling several functions, including *GpiDrawSegment*, *GpiDrawChain*, and *GpiDrawFrom*. Furthermore, you can edit the segment or obtain the binary data that makes up the segment to manipulate or to save to a file. Even when OS/2 runs on an 80286 microprocessor, a segment may be more than 64K.

When you use segments, you are said to be using *retained mode graphics*. The graphics functions are retained in the segment for later rendering on a device. Not all GPI function calls can be stored in segments, however. In particular, none of the GPI *query* functions (such as *GpiQueryColor*) can be stored in segments. A segment is not like a PostScript program, which can dynamically obtain data, perform calculations on it, and pass the results to drawing functions. A segment is instead

merely a very simple collection of graphics commands stored in binary form.

For example, suppose the current position is the point (5,3) and you call the following code in a segment bracket:

```
POINTL ptl ;  
.  
.  
GpiQueryCurrentPosition (hps, &ptl);  
ptl.x += 4 ;  
ptl.y += 4 ;  
GpiLine (hps, &ptl) ;
```

Only the *GpiLine* function is encoded in the segment. The coordinates are those that have been calculated. This code results in 10 bytes stored in the segment:

```
0x01 0x00 0x14 0x00 0x00 0x00 0x0C  
0x00 0x00 0x00
```

The first byte indicates a polyline starting at the current position. The second byte is the number of bytes of data. The next 8 bytes are the 32-bit *x*-coordinate and the 32-bit *y*-coordinate. (The *PMORD.H* header file has descriptions of the codes and structures used in segments.) Coordinates may also be stored in 16-bit form for space efficiency.

GPI also supports storing graphics primitives in a format known as a *metafile*. The *metafile* is an interchange format that can be saved to a file or copied to the clipboard. The metafile is a structured file format that contains graphics state information (such as a color palette) followed by graphics primitives in segment form.

Environments

WHY ARE THERE SEGMENTS?

Sometimes, when approaching a new and unfamiliar system such as the Presentation Manager, programmers feel a need to use all the facilities of that system. They figure that if segments are included in GPI, there must be a reason for them, and hence they ought to be used.

This is not necessarily so. You can write sophisticated graphics programs in OS/2 without dealing with segments at all. Indeed, GPI defines two types of presentation spaces—the *normal* presentation space and the *micro* presentation space—specifically to differentiate between presentation spaces that use segments and those that do not. You can use segments only with a normal presentation space. If you don't want the overhead of the normal presentation space, you should use a micro presentation space instead.

Some programmers may also believe that drawing a segment is inherently faster than directly calling the GPI functions that initially created the segment. Again, this is not so. Segments are not like bitmaps! In general, GPI requires just as much time to render a segment on the screen as it requires to interpret direct drawing functions and render the images on the screen.

There is an exception to this rule. When a lot of computation—particularly floating-point mathematics—is required to calculate coordinates for use in the drawing functions, then drawing a graphics segment is quicker. The reason is that the segment contains only the calculated coordinates and none of the actual calculations. It is also conceivable that at some time in the future the internal structure of GPI (the graphics engine) and the presentation drivers may be changed to allow segments to be converted to special code that could be stored in intelligent devices. This, too, would result in faster rendering, but it is not currently possible.

Why, then, are segments supported at all in GPI? Surprisingly, the primary importance of segments is in anticipating configurations that do not exist today. If a user works at a graphics terminal connected to a remote processor running the PM program, it is usually most efficient for the processor to bundle graphics drawing orders into a packet to send them down the wire to the terminal. This bundle is the segment.

Segments can also be used to provide some structure to your graphics programming. You can create segments that contain collections of primitives that describe a particular image and then render the whole segment with one function call. On the other hand, these primitives can also be called from a function within your program, and you can render them with just a call to the function.

A CAD (computer-aided drawing) program can use segments internally to store a graphics document rather than implementing its own form of storage. Note, however, that the use of segments would lock the

GPI supports segments
for multithreaded
drawing and future
configurations.

CAD program into storing integer rather than floating-point coordinates.

What else is a segment good for? For multithreaded drawing, that's what.

THE GPISSETSTOPDRAW FUNCTION

In the last issue, I said that calling two or more GPI functions for the same presentation space from separate threads at the same time results in an error known as the `PMERR_PS_BUSY` error.

I noted then, however, that there is one exception to this rule: the `GpiSetStopDraw` function. `GpiSetStopDraw` can be called from a thread for a particular presentation space even while another thread has called one of the following six functions for the same presentation space: `GpiDrawChain`; `GpiDrawDynamics`; `GpiDrawFrom`; `GpiDrawSegment`; `GpiPlayMetaFile`; `GpiPutData`.

Of these, the first four functions draw one or more graphics segments. The `GpiPlayMetaFile` function draws the contents of a metafile on a presentation space, and `GpiPutData` draws segment data that has been transferred to local memory directly to a presentation space.

The `GpiSetStopDraw` function interrupts the execution of these six functions. The function that has been interrupted returns control to the thread with a return value of `GPL_ERROR` (equal to 0L). Calling

`WinGetLastError` will reveal an error code of `PMERR_STOP_DRAW_OCCURRED` (equal to 0x2105). This is how the thread knows that segment drawing has been interrupted.

You may also recall that in last issue's `THREADS2` program, I defined a `BOOL` (Boolean) variable named `fContinue` that was normally set to `TRUE`. When the second thread in `THREADS2` is drawing, it periodically checks the value of this variable. When `fContinue` is set to `FALSE` by the main thread, the thread must stop drawing.

I probably don't have to tell you that this is not a highly desirable solution. Suppose you already have a series of functions to draw something on a window. You then decide to move the drawing into a second thread. Now you have to go through all the code and insert periodic checks of `fContinue`. That's not only a hassle, but it makes the code ugly as well.

`GpiSetStopDraw` lets you avoid this nuisance. Internally, GPI is doing something similar to the use of the `fContinue` flag in `THREADS2`, but because GPI does it, you don't have to bother.

This `GpiSetStopDraw` approach to multithreaded drawing is particularly well suited to situations in which, while relatively few function calls are involved in the image, the rendering of those functions takes a long time. This is often the case when clipping is involved in an image—particularly when the clipping areas are nonrectangular. The main thread can create the segment and the second thread can draw the segment. The main thread can then interrupt the second thread (for example, when the size of the window changes) by calling `GpiSetStopDraw`.

AN IMAGE WITH CLIPPING

The image that I chose for the `THREADS3` program, which demonstrates `GpiSetStopDraw`, is shown in Figure 1. It's a variant of an image *PC Magazine* once used to test the speed of PostScript printers and graphics rendering by PostScript clones. An outline of the letters *PC* is used as a clipping area. (The `THREADS3` program does not use a GPI vector font for these letters but instead draws them using lines and a GPI curve known as a *fillet*.) A total of 360 Bézier spline curves are then drawn from the center of the image, each one rotated one degree further counterclockwise from the horizontal.

The image in Figure 1 takes about 45

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seconds to draw on a 20-MHz 80386 machine with a VGA. Clipping is always a lengthy job, particularly when, as here, the clipping area is nonrectangular and the graphics being clipped are fairly complex. However, creating the segment—which requires only that GPI encode all the graphics primitives in a block of memory—takes less than a second. This means that the program can create the segment in its main thread.

THREADS3 scales the image to the size of the client window while maintaining a constant aspect ratio. The image is always displayed in the center of the window. A program that uses segments can scale images in one of two ways. For one, the segment can be re-created whenever the size of the window changes (when the client window receives a WM_SIZE message). Alternatively, it can be created only once, during the WM_CREATE message, and then scaled during rendering. I have chosen the second approach for THREADS3.

The THREADS3 program is shown in Figures 2, 3, and 4. You can compile THREADS3 using the Microsoft C 5.1 compiler and the IBM or Microsoft OS/2 1.2 programmer's toolkits. THREADS3 requires OS/2 1.2 because it makes use of three new functions—GpiRotate, GpiScale, and GpiTranslate—that are not found in Version 1.1.

As with the THREADS1 and THREADS2 programs presented in previous columns, the THREADS3 Make file shows the compiler switches and libraries to use for a multithreaded OS/2 program. The beginning of THREADS3.C includes several C header files located in the MT subdirectory of the normal header file directory. These files are installed with Microsoft C 5.1.

CREATING THE SEGMENT

The action begins during the WM_CREATE message in ClientWndProc. THREADS3 creates a presentation space for the client window by calling GpiCreatePS. Notice the GPIT_NORMAL parameter: this directs GPI to create a normal presentation space (which is required for using segments) rather than a micro presentation space.

The page units of the presentation space are set to PU_LOGLISH, which means

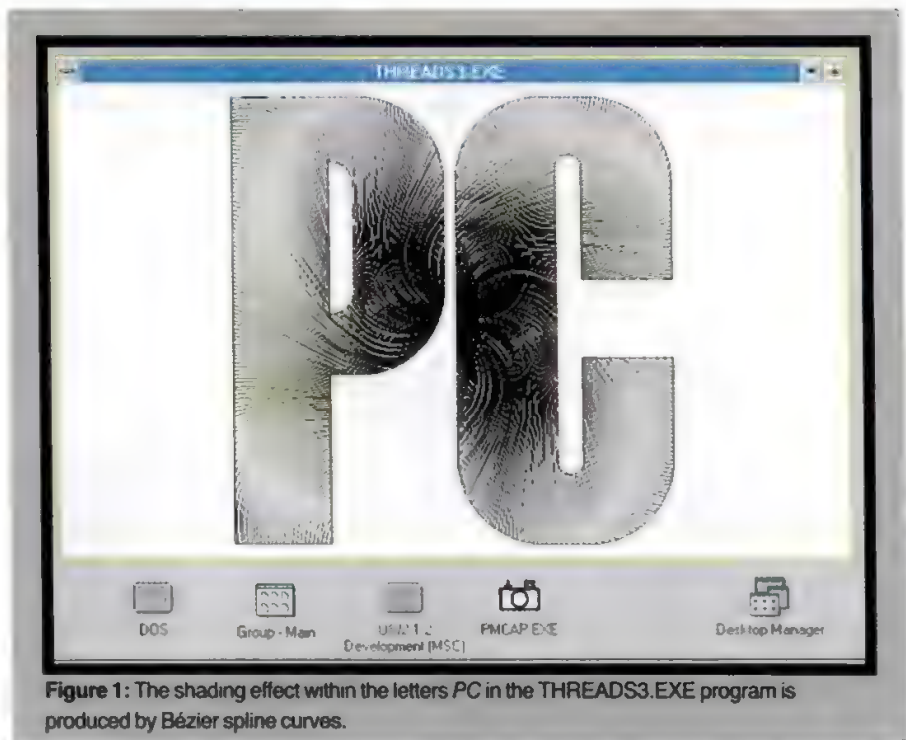


Figure 1: The shading effect within the letters PC in the THREADS3.EXE program is produced by Bézier spline curves.

that GPI interprets coordinates passed to GPI functions as units of 0.01 inch. This helps maintain the correct aspect ratio of the image; the program doesn't have to adjust for video displays with unequal horizontal and vertical resolutions, such as the EGA. Any of the PU (page unit) identifiers, with the exception of PU_PELS, could be used here.

As in the THREADS2 program shown in the previous Environments column, THREADS3 stores the presentation space handle in the THREADPARAMS structure named tp. This structure contains all variables shared between the two threads. The structure also contains two semaphores—semTriggerDraw and semDoingDraw—that the main thread uses to control the drawing thread. (THREADS3 uses these semaphores the same way THREADS2 does, so you may want to see the previous column for a fuller description of what the semaphores do.)

THREADS3 creates the second thread by calling _beginthread. The thread is initially blocked by semTriggerDraw.

THREADS3 calls GpiOpenSegment to create the segment, DrawImage to draw the image into the segment, and GpiCloseSegment to close the segment. Before opening the segment, THREADS3 sets the drawing mode for the presentation space by calling GpiSetDrawingMode with the DM_RETAIN parameter. By default, the drawing mode is DM_DRAWANDRETAIN, which means that GPI will draw the image on the output device as it is saving the primitives in the segment. By specifying DM_RETAIN, the image is only retained and not immediately drawn.

CREATING THE IMAGE

The DrawImage and DrawLetters functions in THREADS3 contain all the graphics primitives that are saved in the segment. DrawImage calls DrawLetters

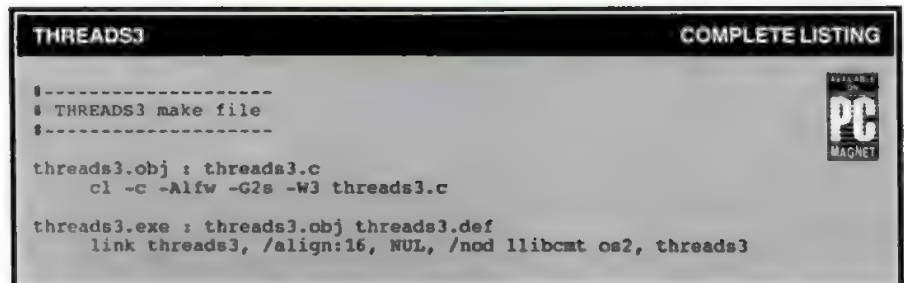


Figure 2: The THREADS3 Make file.

Environments

twice—once to draw the outline of the letters and again in a path bracket (delimited by calls to `GpiBeginPath` and `GpiEndPath`) to make the letter outlines part of a path. The path is used for clipping by a call to `GpiSetClipPath`.

`DrawLetters` consists of a series of calls

to `GpiMove` (to set a current position), `GpiLine` (to draw a line), and `GpiPolyFillet`. The fillet curve is described by three points—a beginning point (the current position), a control point, and an end point. The control point affects the curvature of the line. Fillets are second-degree polynomials based on conic sections.

Notice that the coordinates used in `DrawLetters` are within a box 150 units wide and 150 units high. With page units

of `PULOEGLISH`, this means the image is 1.5 inches wide and high. You'll see later how this image is scaled to the size of the client window.

After `DrawImage` sets the clipping path to the outlines of the letters, it uses a `for` loop for the 360 Bézier spline curves. Toward the end of this loop you'll see some initialization of the `POINTL` array `apL` and calls to `GpiMove` and `GpiPolySpline` to draw a spline curve. (The Bézier spline was discussed in my November 14, 1989, *Environments* column.) The curve is always drawn from the point (0,0) to (100,0), with control points at (33,50) and (67,-50).

Obviously this code by itself doesn't make much sense: why would the program draw 360 spline curves with identical coordinates? Although identical coordinates are passed to the `GpiMove` and `GpiPolySpline` functions, the curves are not drawn in the same place, because the calls are preceded by a call to `GpiSetModelTransformMatrix`.

The model transform matrix defines how the coordinates passed to GPI functions are altered before being used to draw the primitive on the output device. The transform matrix can translate, scale, shear, or rotate coordinates. Although I've never discussed the transform matrices in this column, an extensive discussion can be found in an article I wrote for the July 1988 issue of *Microsoft Systems Journal*.

Prior to OS/2 1.2, Presentation Manager programs were required to define the transform matrix explicitly. Under OS/2 1.2, three functions are available to help. `THREADS3` uses `GpiTranslate` to define a matrix that translates the beginning of the spline curve to the center of the image and `GpiRotate` to define a matrix that rotates the spline curve for each of the 360 angles.

(For better performance, the initialization of the `apL` structure array should be moved outside the `for` loop, for it is loop-invariant. I've put it inside the loop for purposes of clarity.)

Bear in mind that nothing has yet been drawn on the window. All the GPI calls in `DrawImage` and `DrawLetters` are simply saved in the segment for later rendering. At this point, the drawing thread *could* draw the segment on `THREADS3`'s window, but the image would be only 1.5 inches square.

`THREADS3` takes care of this problem while processing the `WM_SIZE` message. The program obtains the size of the client window, converts the size to page coordi-

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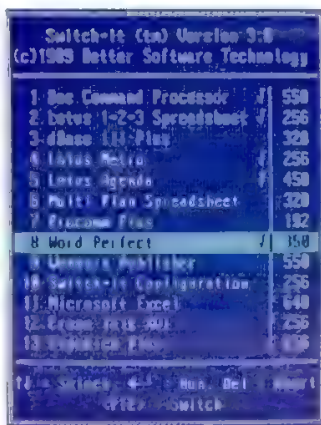
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```

THREADS3.C -- Demonstrates drawing from a second thread
(c) 1990, Ziif Communications Co.
PC Magazine * Charles Petzold, 7/90
-----*/

#define INCL_WIN
#define INCL_GPI
#include <os2.h>
#include <nt/process.h>
#include <nt/stdlib.h>

#define CHIMAGE 150
#define CYIMAGE 150
#define SPLINE 100
#define STACKSIZE (4096 * sizeof (INT))
#define SEGNAME IL
#define PI 3.14159

typedef struct
{
    HPS hps ;
    BOOL fterminate ;
    ULONG semTriggerDraw ;
    ULONG semDoingDraw ;
}
THREADPARAMS ;

MRESULT EXPENTRY ClientWndProc (HWND, USHORT, NPARAM, NPARAM) ;
VOID FAR SecondThread (THREADPARAMS *) ;
ScaleImageToClient (HPS, SIZEL *) ;
DrawImage (HPS) ;
DrawLetters (HPS) ;

EAT hab ;

int main (void)
{
    static CHAR szClientClass [] = "Threads3" ;
    static ULONG flFrameFlags = FCF_TITLEBAR | FCF_SYSMENU |
                                FCF_SIZEBOX | FCF_MINMAX |
                                FCF_SCROLLBARS | FCF_TASKLIST ;

    HAB hab ;
    HMQ hmq ;
    HWND hwndFrame, hwndClient ;
    QMSG qmsg ;

    hab = WinInitialize (0) ;
    hmq = WinCreateMsgQueue (hab, 0) ;
    WinRegisterClass (hab, szClientClass, ClientWndProc, CS_SIZEBOX, 0) ;

    hwndFrame = WinCreateStdWindow (HWND_DESKTOP, WS_VISIBLE,
                                    flFrameFlags, szClientClass, NULL,
                                    0, 0, 0, &hwndClient) ;

    while (WinGetMsg (hab, &qmsg, NULL, 0, 0))
        WinDispatchMsg (hab, &qmsg) ;

    WinDestroyWindow (hwndFrame) ;
    WinDestroyMsgQueue (hmq) ;
    WinTerminate (hab) ;
    return 0 ;
}

MRESULT EXPENTRY ClientWndProc (HWND hwnd, USHORT msg, NPARAM mpi, NPARAM mp2)
{
    static int aiThreadStack [STACKSIZE / sizeof (int)] ;
    static THREADPARAMS tp ;
    HDC hdc ;
    SIZEL szl ;
    szlPage, szlClient ;

    switch (msg)
    {
        case WM_CREATE:
            // create a presentation space for the window

            hdc = WinOpenWindowDC (hwnd) ;
            szlPage.cx = 0 ;
            szlPage.cy = 0 ;
            tp.hps = GpiCreatePS (hab, hdc, szlPage,
                                PU_LOENGHISH | GPI_DEFAULT |
                                GPIT_NORMAL | GPI_ASSOC) ;

            // start the thread after initialization

            tp.fterminate = FALSE ;

            DosSemSet (&tp.semTriggerDraw) ;
            DosSemClear (&tp.semDoingDraw) ;

            _beginthread (SecondThread, aiThreadStack, STACKSIZE, &tp) ;

            // create the segment

            GpiSetDrawingMode (tp.hps, DM_RETAIN) ;

            GpiOpenSegment (tp.hps, SEGNAME) ;
            DrawImage (tp.hps) ;
            GpiCloseSegment (tp.hps) ;
            return 0 ;

        case WM_SIZE:
            // stop the thread from drawing

            GpiSetStopDraw (tp.hps, SDW_ON) ;
            DosSemWait (&tp.semDoingDraw, SEM_INDEFINITE_WAIT) ;

            // get new size of client window

            szlClient.cx = SHORTFROMMP (mp2) ;
            szlClient.cy = SHORTFROMMP (mp2) ;

            // set the new default view matrix
    }
}

```

```

GpiConvert (tp.hps, CVTC_DEVICE, CVTC_PAGE, IL,
            (PPPOINTL) &szlClient) ;

return 0 ;

case WM_PAINT:
    // stop the thread from drawing

    GpiSetStopDraw (tp.hps, SDW_ON) ;
    DosSemWait (&tp.semDoingDraw, SEM_INDEFINITE_WAIT) ;

    // erase the window

    WinBeginPaint (hwnd, tp.hps, NULL) ;
    GpiErase (tp.hps) ;
    WinEndPaint (tp.hps) ;

    // let the thread continue

    GpiSetStopDraw (tp.hps, SDW_OFF) ;
    DosSemSet (&tp.semDoingDraw) ;
    DosSemClear (&tp.semTriggerDraw) ;
    return 0 ;

case WM_DESTROY:
    // stop the thread

    tp.fterminate = TRUE ;
    GpiSetStopDraw (tp.hps, SDW_ON) ;
    DosSemWait (&tp.semDoingDraw, SEM_INDEFINITE_WAIT) ;

    // clean up

    GpiDeleteSegment (tp.hps, SEGNAME) ;
    GpiAssociate (tp.hps, NULL) ;
    GpiDestroyPS (tp.hps) ;
    return 0 ;

}

return WinDefWindowProc (hwnd, msg, mpi, mp2) ;
}

VOID CDECL FAR SecondThread (THREADPARAMS * ptp)
{
    HAB hab ;

    hab = WinInitialize (0) ;

    while (!ptp->fterminate)
    {
        // wait for the semaphore to be cleared

        DosSemWait (&ptp->semTriggerDraw, SEM_INDEFINITE_WAIT) ;

        // draw the image

        GpiSavePS (ptp->hps) ;
        GpiDrawSegment (ptp->hps, SEGNAME) ;
        GpiRestorePS (ptp->hps, -1) ;

        // set and clear the semaphores

        DosSemSet (&ptp->semTriggerDraw) ;
        DosSemClear (&ptp->semDoingDraw) ;

        WinTerminate (hab) ;
        _endthread () ;
    }

    VOID ScaleImageToClient (HPS hps, SIZEL *pszlClient)
    {
        FIXED afxScale[2] ;
        MATRIXLP matlf ;
        POINTL ptl ;

        afxScale[0] = afxScale[1] = min (65536L * pszlClient->cx / CHIMAGE,
                                         65536L * pszlClient->cy / CYIMAGE) ;

        ptl.x = 0 ;
        ptl.y = 0 ;

        GpiScale (hps, &matlf, TRANSFORM_REPLACE, afxScale, &ptl) ;

        ptl.x = (pszlClient->cx - afxScale[0] * CHIMAGE / 65536L) / 2 ;
        ptl.y = (pszlClient->cy - afxScale[1] * CYIMAGE / 65536L) / 2 ;

        GpiTranslate (hps, &matlf, TRANSFORM_ADD, &ptl) ;

        GpiSetDefaultViewMatrix (hps, 0, &matlf, TRANSFORM_REPLACE) ;
    }

    VOID DrawImage (HPS hps)
    {
        MATRIXLP matlf ;
        POINTL ptl, optl[4] ;
        SHORT iAngle ;

        // Draw outline of letters

        DrawLetters (hps) ;

        // Use letters outline as clipping path

        GpiBeginPath (hps, IL) ;
        DrawLetters (hps) ;
        GpiEndPath (hps) ;
        GpiSetClipPath (hps, IL, SCP_AND | SCP_ALTERNATE) ;

        for (iAngle = 0 ; iAngle < 360 ; iAngle++)
        {
            // Find matrix for rotation around origin
        }
    }
}

```

Figure 3: The THREADS3.C source code listing contains several new functions that require OS/2 1.2.

THREADS3.C

2 of 2

```

ptl.x = 0 ;
ptl.y = 0 ;
GpiRotate (hps, &matlf, TRANSFORM_REPLACE,
MAKEFIXED (iAngle, 0), &ptl) ;

// Append matrix for translation to center of image

ptl.x = CXIMAGE / 2 ;
ptl.y = CYIMAGE / 2 ;
GpiTranslate (hps, &matlf, TRANSFORM_ADD, &ptl) ;

// Set model transform using composite matrix

GpiSetModelTransformMatrix (hps, 9L, &matlf, TRANSFORM_REPLACE) ;

// Draw spline curve

aptl[0].x = 0 ;
aptl[0].y = 0 ;

aptl[1].x = SPLINE / 3 ;
aptl[1].y = SPLINE / 2 ;

aptl[2].x = 2 * SPLINE / 3 ;
aptl[2].y = - SPLINE / 2 ;

aptl[3].x = SPLINE ;
aptl[3].y = 0 ;

GpiMove (hps, aptl) ;
GpiPolySpline (hps, 3L, aptl + 1) ;

VOID DrawLetters (HPS hps)
{
    POINTL ptl, aptl[3] ;

    // Outside of 'P'

    ptl.x = 4 ; ptl.y = 4 ; GpiMove (hps, aptl) ;
    ptl.x = 4 ; ptl.y = 146 ; GpiLine (hps, aptl) ;
    ptl.x = 45 ; ptl.y = 146 ; GpiLine (hps, aptl) ;
    aptl[0].x = 72 ; aptl[0].y = 146 ;
    aptl[1].x = 72 ; aptl[1].y = 119 ; GpiPolyFillet (hps, 2L, aptl) ;

    ptl.x = 72 ; ptl.y = 85 ; GpiLine (hps, &ptl) ;
    aptl[0].x = 72 ; aptl[0].y = 58 ;
    aptl[1].x = 45 ; aptl[1].y = 58 ; GpiPolyFillet (hps, 2L, aptl) ;
    ptl.x = 35 ; ptl.y = 58 ; GpiLine (hps, aptl) ;
    ptl.x = 35 ; ptl.y = 4 ; GpiLine (hps, aptl) ;
    ptl.x = 4 ; ptl.y = 4 ; GpiLine (hps, aptl) ;

    // Inside of 'P'

    ptl.x = 35 ; ptl.y = 77 ; GpiMove (hps, aptl) ;
    ptl.x = 35 ; ptl.y = 125 ; GpiLine (hps, aptl) ;
    aptl[0].x = 43 ; aptl[0].y = 125 ;
    aptl[1].x = 43 ; aptl[1].y = 117 ; GpiPolyFillet (hps, 2L, aptl) ;
    ptl.x = 43 ; ptl.y = 85 ; GpiLine (hps, &ptl) ;
    aptl[0].x = 43 ; aptl[0].y = 77 ;
    aptl[1].x = 35 ; aptl[1].y = 77 ; GpiPolyFillet (hps, 2L, aptl) ;

    // Outline of 'C'

    ptl.x = 116 ; ptl.y = 63 ; GpiMove (hps, aptl) ;
    ptl.x = 145 ; ptl.y = 63 ; GpiLine (hps, aptl) ;
    ptl.x = 145 ; ptl.y = 31 ; GpiLine (hps, aptl) ;
    aptl[0].x = 145 ; aptl[0].y = 4 ;
    aptl[1].x = 116 ; aptl[1].y = 4 ; GpiPolyFillet (hps, 2L, aptl) ;
    ptl.x = 183 ; ptl.y = 4 ; GpiLine (hps, aptl) ;
    aptl[0].x = 76 ; aptl[0].y = 4 ;
    aptl[1].x = 76 ; aptl[1].y = 31 ; GpiPolyFillet (hps, 2L, aptl) ;
    ptl.x = 76 ; ptl.y = 119 ; GpiLine (hps, aptl) ;
    aptl[0].x = 76 ; aptl[0].y = 146 ;
    aptl[1].x = 183 ; aptl[1].y = 146 ; GpiPolyFillet (hps, 2L, aptl) ;
    ptl.x = 116 ; ptl.y = 146 ; GpiLine (hps, aptl) ;
    aptl[0].x = 145 ; aptl[0].y = 146 ;
    aptl[1].x = 145 ; aptl[1].y = 119 ; GpiPolyFillet (hps, 2L, aptl) ;
    ptl.x = 145 ; ptl.y = 88 ; GpiLine (hps, aptl) ;
    ptl.x = 116 ; ptl.y = 88 ; GpiLine (hps, aptl) ;
    ptl.x = 116 ; ptl.y = 123 ; GpiLine (hps, aptl) ;
    aptl[0].x = 116 ; aptl[0].y = 127 ;
    aptl[1].x = 188 ; aptl[1].y = 127 ; GpiPolyFillet (hps, 3L, aptl) ;
    ptl.x = 188 ; aptl[2].y = 123 ;
    aptl[0].x = 188 ; ptl.y = 38 ; GpiLine (hps, aptl) ;
    aptl[0].x = 188 ; aptl[0].y = 26 ;
    aptl[1].x = 116 ; aptl[1].y = 26 ;
    aptl[2].x = 116 ; aptl[2].y = 38 ; GpiPolyFillet (hps, 3L, aptl) ;
    ptl.x = 116 ; ptl.y = 63 ; GpiLine (hps, aptl) ;

```

nates (units of 0.01 inches) by calling GpiConvert, and passes the window size to the ScaleImageToClient function.

The ScaleImageToClient function uses another GPI matrix transform—the default view matrix. The default view matrix is often used to translate, scale, or rotate an entire image. The model transform matrix used in the DrawImage function is often used to translate, scale, and rotate individual primitives (or groups of primitives) within an image. In this case, the image is scaled to the size of the client window and translated to appear in the center of the client window. ScaleImageToClient uses the OS/2 1.2 GpiScale and GpiTranslate functions to define the matrix before calling GpiSetDefaultViewMatrix.

THREAD COORDINATION

Now that we've examined most of the GPI overhead in THREADS3, it's time to look at how the program uses the second thread for drawing.

The SecondThread function is used for the drawing thread. When this thread was started, during WM_CREATE processing in ClientWndProc, the semTriggerDraw semaphore was set. The drawing thread waits in the DosSemWait function until this semaphore is cleared.

During the first WM_SIZE message, (which occurs sometime between the

WM_CREATE message and the first WM_PAINT message), ClientWndProc calls GpiSetStopDraw with the SDW_ON parameter to stop any current segment drawing. This has no effect during the first WM_SIZE message. It then waits for the semDoingDraw semaphore to be cleared. Because the semaphore was initially cleared during the WM_CREATE message, this also has no immediate effect. As described above, ClientWndProc calls ScaleImageToClient to set the default view matrix for the presentation space.

During the first WM_PAINT message, GpiSetStopDraw and DosSemWait are called again and, as in the first WM_SIZE message, they have no effect. ClientWndProc then erases the window and concludes WM_PAINT processing by calling GpiSetStopDraw with the parameter

SDW_OFF, setting the semDoingDraw semaphore and clearing the semTriggerDraw semaphore.

The drawing thread, until now waiting for the semTriggerDraw semaphore to be cleared, is now unblocked. It calls GpiDrawSegment to draw the segment on the client window. The drawing will continue until the image is completed or until the main thread interrupts the drawing by calling GpiSetStopDraw with a parameter of SDW_ON.

The GpiDrawSegment call is bracketed by calls to GpiSavePS and GpiRestorePS. These calls save and restore the attributes of the presentation space, including the model-transform matrix. The reason for this is simple: because the segment sets nondefault model-transform matrices, the last model-transform matrix called within

THREADS3.DEF		COMPLETE LISTING
<pre>----- ; THREADS3.DEF module definition file -----</pre>		
NAME	THREADS3 WINDOWAPI	
DESCRIPTION	'Second Thread Drawing Demo (c) 1990, Ziff Communications Co.'	
PROTMODE		
HEAPSIZE	1024	
STACKSIZE	8192	

Figure 4: The THREADS3.DEF module-definition file.

Environments

the segment would still be in effect when the segment was drawn again. Saving and restoring the presentation-space attributes prevents this.

When the segment is finished or interrupted, it sets the semTriggerDraw semaphore and clears the semDoingDraw semaphore, and then returns to the top of the while loop, waiting for semTriggerDraw to be cleared.

The drawing is interrupted (if necessary), during the WM_SIZE or WM_PAINT messages, by calls to GpiSetStopDraw with SDW_ON. In either case ClientWndProc waits for the second

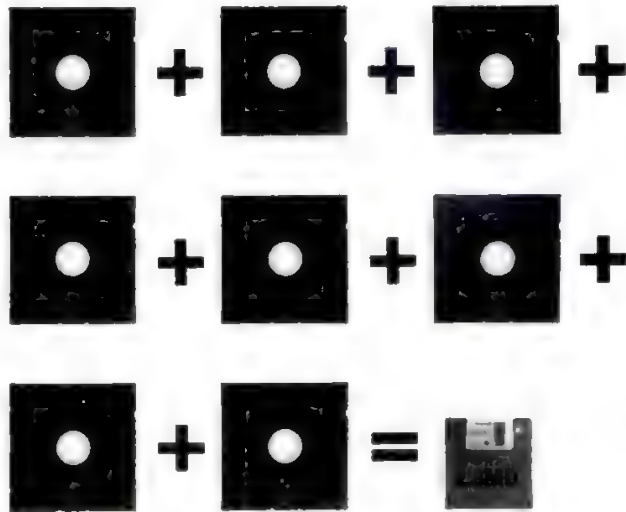
The use of segments and GpiSetStopDraw allows a Presentation Manager graphics program to be more cleanly structured.

thread to signal (by clearing the semDoingDraw semaphore) that it is no longer drawing. This allows the main thread to make changes to the presentation space safely while the drawing thread is not making any GPI calls.

As I mentioned earlier, much of the architecture of this program is very similar to the THREADS2 program presented in the last issue. However, the use of segments and GpiSetStopDraw allows the program to be more cleanly structured. The program doesn't need to define an obtrusive flag (called fContinue in THREADS2) that the drawing code periodically checks.

WRAPPING UP

I'll conclude this extended discussion of multithreaded drawing in the next two issues, with a program that combines techniques shown in the earlier THREADS1 and THREADS2 programs. This will be a Presentation Manager program of a fractal image that eats up CPU time like potato chips—the famous *Mandelbrot set*. ■

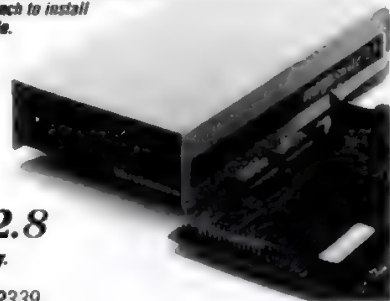


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CIRCLE 514 ON READER SERVICE CARD

by
Ray Duncan

Power Programming

An Overview of the OS/2 2.0 Memory Management Scheme

The 80386-specific version of OS/2 differs in many ways from its 16-bit predecessors, but the most striking differences are found in the realm of memory management. Not a single OS/2 2.0 API function related to memory allocation or sharing has survived unchanged! Ironically, programmers who have had the most experience with OS/2—the pioneers who've been using it since Version 1.x—may find it harder to adapt to OS/2 2.0 than those who come to it from other CPU architectures or even from DOS. It's not easy to discard the painfully learned tricks and techniques that yield good performance in a segmented architecture—even when you know they can be harmful in the OS/2 2.0 environment.

In my next column, we'll consider OS/2 2.0's new memory management API and how it takes advantage of advanced features of the 80386. First, however, we must review the mechanisms for memory protection and addressing on the 80286 and 80386. I've discussed these topics previously in the contexts both of the eXtended Memory Specification (XMS) and of 80386 DOS Extenders. They must be examined again, but this time from the standpoint of a true protected-mode operating system and its client applications.

80286 PROTECTED-MODE ADDRESSING

When the 80286 is running in protected mode, memory protection and virtual memory is supported in the hardware by a layer of indirection in memory-address generation. The value in a segment register is called a *selector* and, as shown in Figure 1, it consists of several bit fields. The upper 13 bits are an index into a descriptor table—a special data structure maintained by the operating system and interpreted by the hardware. The combination of selector and offset is called a virtual address.

The entries in a descriptor table are called, naturally, descriptors. Descriptors come in several types, with varying formats, but they are always 8 bytes long. An 80286 descriptor for an ordinary memory segment contains its base address, length,

■ The task of combining compatibility with 80286 applications and with the older OS/2 1.x versions calls for a programming tour de force by OS/2 2.0.

and access rights, together with several reserved fields. The layout is shown in Figure 2. The access-rights byte is particularly important because it defines, among other things, the way in which a segment may be used (executable, writable data, or read-only data), the privilege level needed to access the segment, and whether the segment represented by the selector is present in physical memory.

A selector, then, is like a file handle: it symbolizes data but its value has no direct

correspondence to that data's location. Whenever an instruction references memory, a segment register is selected, either implicitly (by the instruction type) or explicitly (by a segment-register override). The CPU looks up the descriptor that corresponds to the selector in the segment register and uses the information in the descriptor to validate the memory access. If it finds no reason to bar the access, it forms a physical memory address by combining the base address from the descriptor with a 16-bit offset from the instruction and/or one or more registers, as depicted in Figure 3. If the access is to be disallowed, the CPU generates a memory-protection exception similar to a hardware interrupt.

The essential linkage between the hardware and the software in this address-translation scheme is provided by a Global Descriptor Table (GDT). Before the CPU is switched into protected mode, a GDT must be constructed that contains (at a minimum) descriptors for a code segment and a data segment to be used by the current program. Further, the physical address and length of the GDT must be loaded into the Global Descriptor Table Register (GDTR). Normally, the initial GDT contains many other descriptors as well, including one that maps the GDT itself as a writable data segment. (This last permits the GDT to be modified after the switch to protected mode.)

Another descriptor table, called the Interrupt Descriptor Table (IDT), defines the virtual addresses of the system's protected-mode interrupt handlers. As with the GDT, the physical address and length of

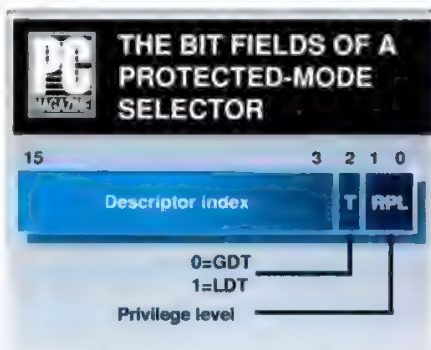


Figure 1: Selectors are like file handles: they represent data without giving its location. The hardware refers to a descriptor table to find the true memory address symbolized by a selector.

Power Programming

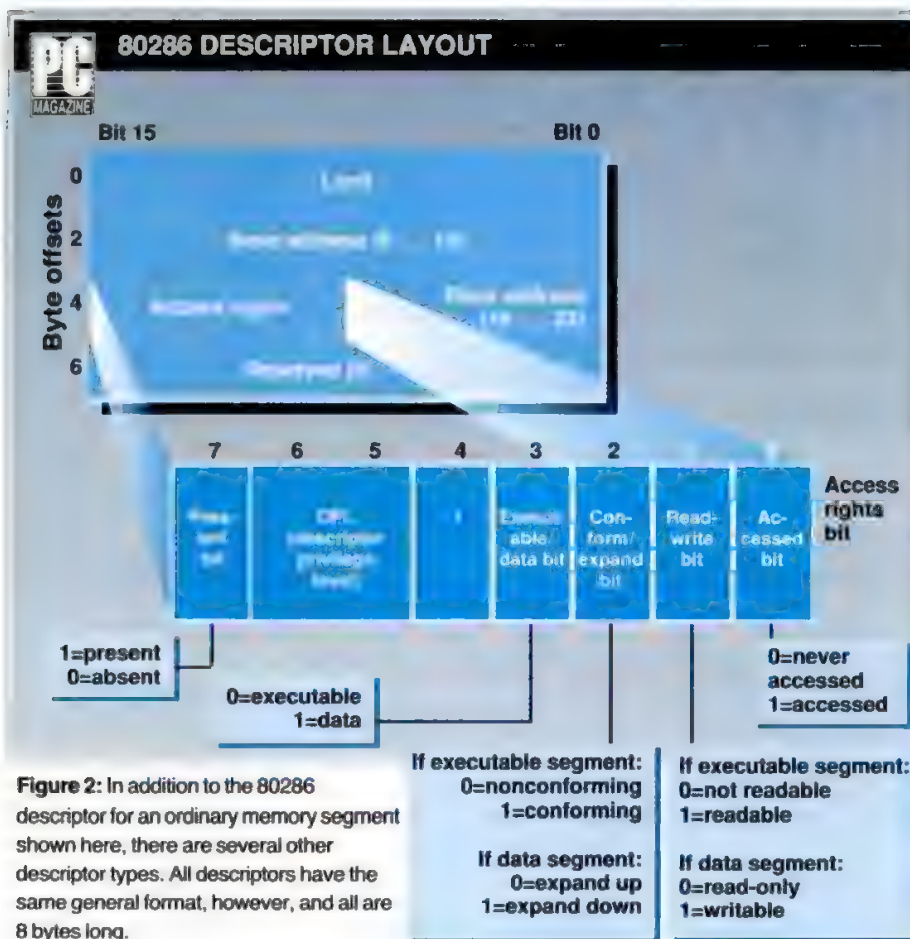


Figure 2: In addition to the 80286 descriptor for an ordinary memory segment shown here, there are several other descriptor types. All descriptors have the same general format, however, and all are 8 bytes long.

the IDT are loaded into the CPU's Interrupt Descriptor Table Register (IDTR) before the switch to protected mode. Again, in order for the IDT to be modifiable after the switch to protected mode, a descriptor that maps the IDT as a writable data segment must be present in the GDT.

The GDT and IDT are thus the crucial anchors for protected-mode execution. Other descriptor tables can exist in the system as well, but only one such additional table—called a Local Descriptor Table (LDT)—can be in use at any given time. Each LDT is a memory segment that is mapped by a special descriptor in the GDT. A particular LDT is activated by loading its GDT selector into the Local Descriptor Table Register (LDTR). Bit 2 of a selector determines whether its descriptor is in the GDT or in the current LDT.

PUTTING IT ALL TOGETHER

How can an operating system such as OS/2 make use of all these tables and structures to provide a fully protected, multitasking,

virtual-memory environment for application programs?

First, and most important, the operating system reserves the manipulation of descriptor tables to itself. Since the operating system is in control throughout the boot process and at the time of the initial switch to protected mode, this is easy to arrange. The OS simply constructs the descriptors for the GDT and the Interrupt Descriptor Table (IDT)—as well as the descriptors for its own code and data in the GDT—so that they can be accessed only by code that is running at the highest privilege level. It then makes sure that it never allows any application to run at that privilege level.

Next, the operating system reserves the service of memory-protection exceptions to its own interrupt handlers. This is easy to arrange, because the IDTR is loaded during system initialization. The writable selector that corresponds to the IDT's memory is located in the GDT, so it, too, is controlled by the operating system. Consequently, an application program can't

install an interrupt handler without the cooperation of the operating system. And again, in the case of the interrupt descriptors that correspond to the various memory-protection exceptions, the operating system chooses not to cooperate.

Finally, the operating system segregates one application from another by putting the descriptors for each program's code and data into a separate LDT and then enabling the proper LDT as part of a context switch. As a result, the memory that does not belong to an application is not visible to that application. If a program tries to use a selector for which it has an insufficient privilege level or one for which no corresponding descriptor exists, or if it uses an offset that is greater than the segment size specified in the descriptor's limit field, an exception called a *general protection* (GP) fault is generated. The operating system's handler then regains control and the application is terminated.

The typical 80286 protected-mode virtual-memory operating system distributes memory management among three modules. The lowest-level module is the *physical memory manager* (PMM). The PMM views RAM as a contiguous linear sequence of bytes with physical addresses from 000000h to FFFFFFFh. The PMM divides the physical address space into chunks called arenas, which it allocates on demand. Each arena is preceded by an arena header indicating the arena's length and whether it is available or in use.

The next level is the *virtual memory manager* (VMM). The VMM creates memory segments on demand by calling the PMM to allocate an arena of an appropriate size, building a descriptor in the GDT or LDT, and returning a selector that can be used to address the segment. When physical memory becomes so fragmented that an allocation request cannot be met, the VMM works with the PMM to consolidate free arenas by moving existing segments around and updating the base addresses in their descriptors. If insufficient physical memory is available, then the third memory-management module, the *swapper*, comes into play.

The VMM first identifies a segment that has not been recently used. If the segment was a read-only data or an executable segment that can be reloaded from a program file, the VMM clears the *present* bit in the descriptor and calls the PMM to release the physical memory owned by the segment. If the segment contained modifiable data, the VMM calls the swapper to

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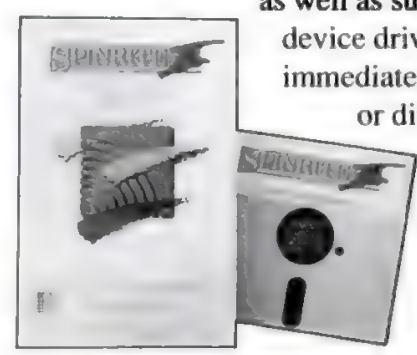
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write the segment's contents to a swap file on-disk, clears the present bit, and then releases the physical memory. The process of discarding or swapping segments is repeated as many times as it takes to satisfy the new segment-allocation request.

What becomes of a swapped-out or discarded segment? The next time the selector for that segment is referenced by a program, the hardware finds the present bit in the descriptor cleared. It then generates a "segment not present" exception. This exception is fielded by the operating system, which passes control to the VMM. The VMM then allocates physical memory to hold the segment (possibly swapping or discarding one or more other segments to get the memory), calls the swapper to read the segment back in from disk, updates the descriptor with the new physical base address, sets the present bit in the descriptor, and finally executes an interrupt return to restart the instruction that caused the exception in the first place.

The VMM also has the responsibility of maintaining multiple descriptors, called *aliases*, that represent the same physical memory segment in different ways. For example, a segment that contains an application's machine code must be mapped in two ways. A descriptor with the executable attribute must exist for the segment so that the program has a valid CS selector. But another descriptor with the writable data attribute must exist so that the operating system can load the program's code into the segment from disk and do the necessary relocations. Alias tracking is one of the more-complex problems that must be solved in the implementation of a VMM, because the hardware provides no aid.

You've seen the physical structures that underlie the generation of memory addresses in protected mode, so you can understand why there are no software tricks to deliver us from the 80286's basic limitations. The 16-bit limit field of a descriptor corresponds to the 64K maximum segment size, and the descriptor's 24-bit base address limits the physical address space to 16MB. The virtual address space available to an application program is limited to 512MB, in two ways. First, the LDT is really a segment, so its maximum size is 64K—room enough for 8,192 8-byte descriptors. $8K \times 64K$ (the maximum amount of memory mapped by one de-

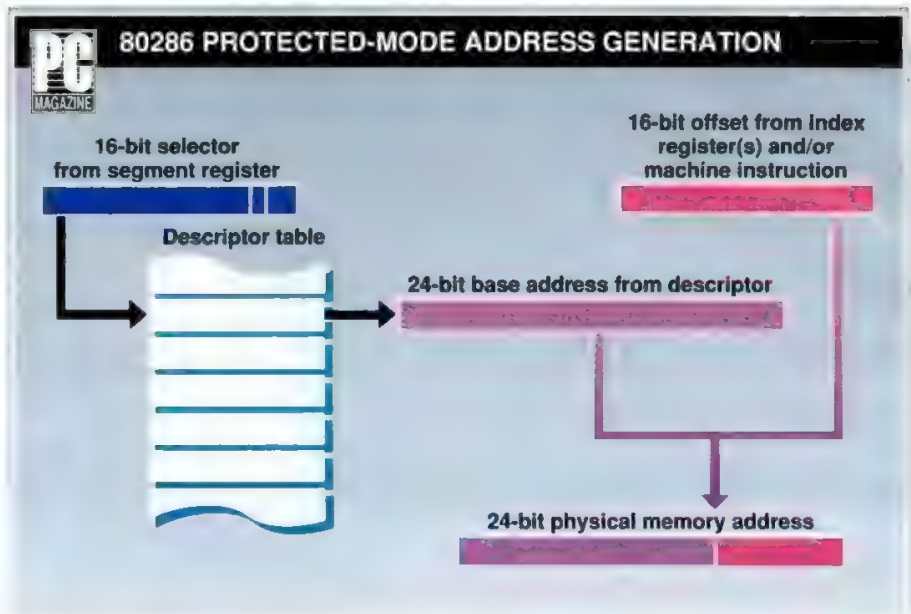


Figure 3: In 80286 16-bit protected mode, physical addresses are generated from a selector and offset. The upper 13 bits of the selector serve as an index into a descriptor table. The segmentation hardware combines the 24-bit base address from a descriptor with a 16-bit offset to form a 24-bit physical memory address.

scriptor) is 512MB. Second, the descriptor index field in a selector is 13 bits wide, so descriptors can be numbered from 0 to 1FFFh (8,191)—leading again to the 512MB maximum.

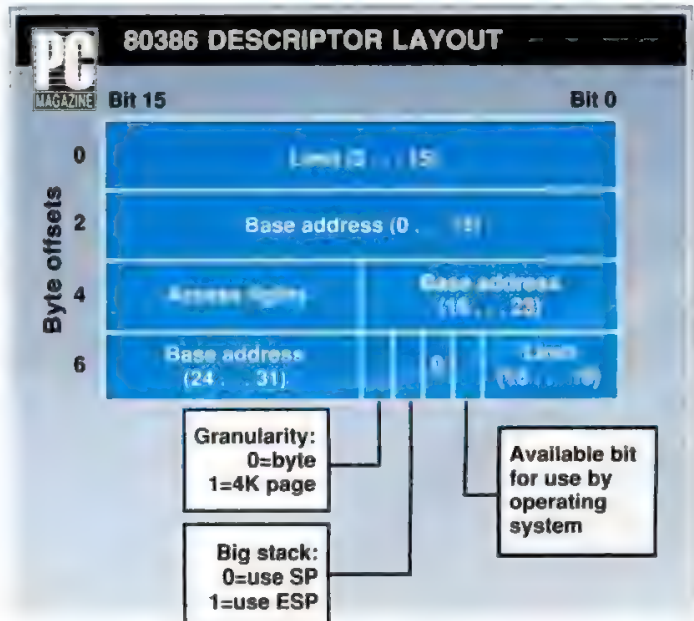
80386 PROTECTED-MODE ADDRESSING

As shown in Figure 4, memory addressing in 80386 protected mode is a proper superset of the addressing mechanisms found on the 80286. Selectors and descriptors look much the same, except that the descriptor

fields that were unused on the 80286 are brought into play so that the descriptor can accommodate a 32-bit base address and support segment sizes as large as 4GB.

But beneath the selector/descriptor mechanism, the 80386 introduces yet another, optional layer of address translation, called paging. The paging hardware sees physical memory as an array of 4K chunks, or *pages*. Once a linear, 32-bit address has been generated by combining the base address from a descriptor with a 32-

Figure 4: 80386 descriptors, such as the one shown here for an ordinary memory segment, follow the same general scheme as those for the 80286, except the reserved fields of the 80286 descriptors are used to allow segments as large as 4GB.



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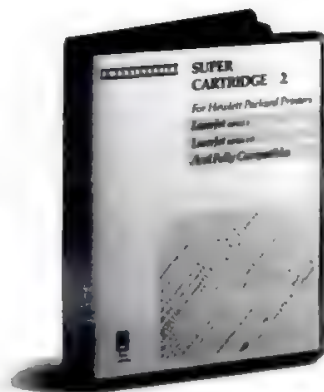
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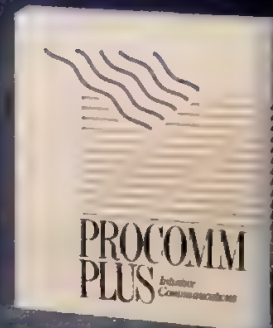
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bit offset, the 80386's paging unit can map this linear address onto a different physical address. It does this by treating the upper 20 bits of the linear address as a logical page number, translating the logical page number into a physical page number, and adding the lower 12 bits of the linear address onto the physical page's base address to get a 32-bit physical memory address. The procedure is shown in Figure 5.

The correspondence between logical pages and physical pages, and thus between linear addresses and physical addresses, is controlled by data structures called page tables and a page-table directory. Since they are built by the operating system and interpreted by the hardware, these structures are in a sense analogous to descriptor tables. On the other hand, the individual entries in page tables or directories bear little resemblance to descriptors. In fact, as you can see from Figure 6, there is hardly anything in a page-table entry that an 80286 programmer will find familiar.

The paging hardware provides support for memory protection and virtual memory that is totally independent of the support at the selector/descriptor level. The contents of the page tables and directory as a whole determine which linear addresses are valid in the context of the current process, while individual page-table entries determine whether a particular page is read-only or read-write, and whether it is accessible by a program running at the lowest privilege level or only by the operating system. Each page-table entry also contains present, accessed, and "dirty" bits. These bits indicate, respectively, whether the page's data is present in physical memory, whether the page was accessed since the last time the access bit was cleared, and whether the page was written to since the last time the dirty bit was cleared.

The crucial link between the hardware and the software for hardware paging is the CPU's Control Register 3 (CR3), which contains the physical memory address of the page-table directory. Paging is turned on when the operating system loads the CR3 register, then sets the PG (page enable) bit in Control Register 0 (CR0). Both of these control registers can be written only by a program running at the highest privilege level. Thus it is impossible for an application program to grab control of the paging system from the operating system.

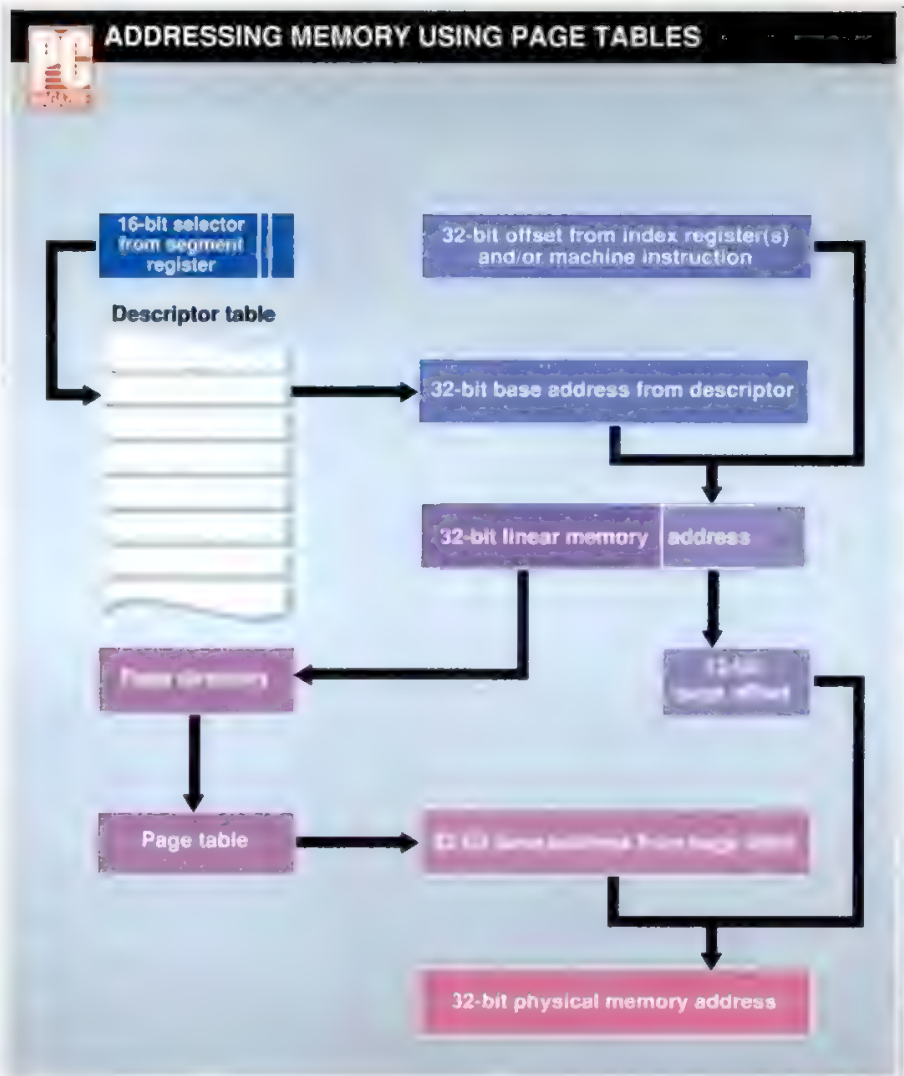


Figure 5: The 80386 uses two layers of address translation when paging is enabled. The selector and offset are translated to a 32-bit linear address, which is then translated by the paging unit into a 32-bit physical address.

IMPLICATIONS FOR AN 80386 OS

The two layers of memory protection and address mapping for the 80386 let an operating system designer choose from several different memory models: simple flat model, segmented model, paged flat model, and segmented paged model.

An operating system based on the simple flat model defines all memory as a single segment (which can be as large as 4GB). The paging hardware is disabled. The GDT can be very small, as it must contain only an executable descriptor and a writable data descriptor that map the same segment. A local descriptor table is unnecessary. Memory protection is essentially inoperative, because the segment registers are loaded at boot-time and never altered thereafter. All program code and data live in the same address space, all jumps and

calls are near, and all variables can be reached with 32-bit offsets. The simple flat model is convenient in embedded systems in which all code can be trusted, but it's impractical for multitasking systems.

In the pure segmented model, the paging hardware is disabled and protection is provided only at the selector/descriptor level. An 80386 operating system based on this model would look much like OS/2 1.x except that segment sizes, instead of being restricted to 64K, could be as large as 4GB. But virtual memory management in the pure segmented 80386 model would be a beastly chore, which is why no operating system uses it. Imagine the delays that could be incurred if the VMM and PMM had to move 4GB segments to consolidate free physical memory. Or the problems that the swapper would encounter in trying

Power Programming

to swap segments that could range in size from 1 byte to 4GB!

The paged flat model is similar to the simple flat model except that the paging hardware is enabled. Again, the segment registers are loaded once with selectors that map all of the linear address space. Protecting the operating system code and data from application programs is implemented via the page tables. Segregation of one application's code and data from another's is also accomplished with the page tables: as part of a context switch, the operating system edits the page tables and page-table directory to make the previous application's physical pages invisible and the new application's physical pages visible in the linear address space.

The job of the operating system's VMM and swapper is very simple in a paged memory model. Physical memory is always allocated in 4K chunks, the swap file is always read or written in 4K chunks, and since the mapping of linear addresses onto physical addresses is completely controlled in the page tables, there is never a need to move things around in physical memory. The dirty bits in the page table entries, which are set when the corresponding page is written to, also allow the swapper to avoid many unnecessary disk writes. This is because if the swapper knows that a page has not been changed, and it knows where on the disk to get a fresh copy of the page when it needs it, it can reassign the physical page without rolling the page's contents out to disk first.

A segmented paged memory model for an 80386 operating system combines the advantages of the segmented and the paged models. Memory can be protected at two levels: descriptors and page tables. Memory can be allocated with a granularity of 1 byte, while swapping is carried out on the basis of a 4K page rather than on a segment basis. But the segmented paged model is expensive, both in terms of execution speed (because of segment register loads) and in terms of memory (to support both local descriptor tables and page tables). Worst of all, it still requires programmers to think about memory addressing in terms of 48-bit far pointers, which have a selector component that can't be arithmetically manipulated.

Which of these memory models does OS/2 2.0 use? From the point of view of a

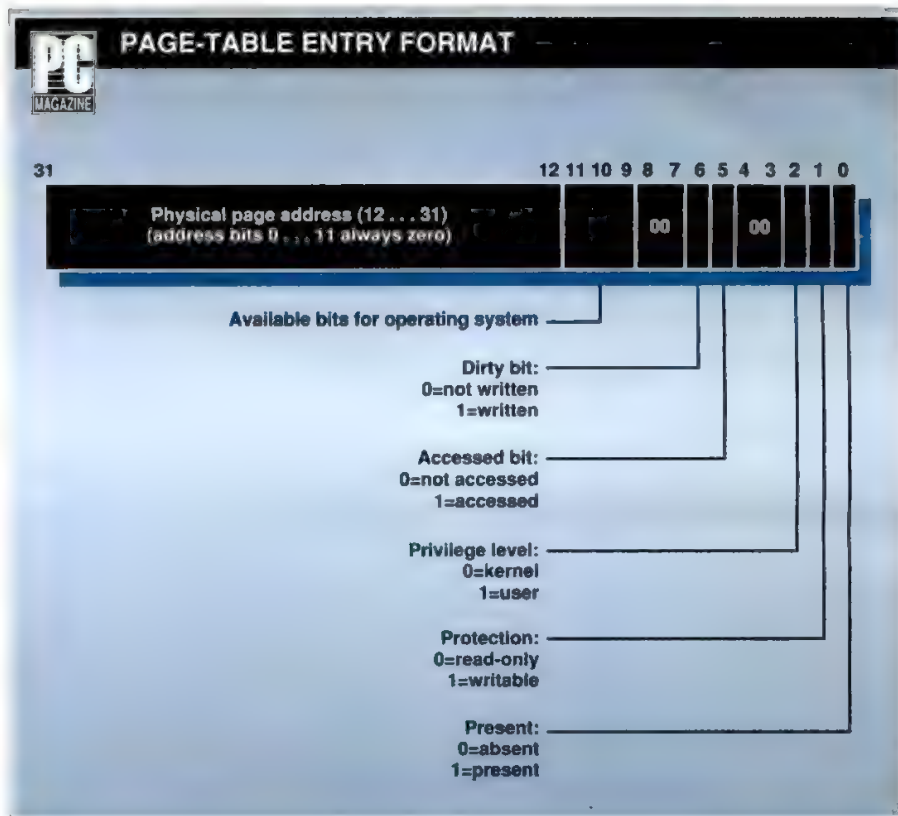


Figure 6: The individual fields of the page table and the page-table directory entry control the correspondence between logical and physical pages. These fields also provide support for memory protection and swapping in terms of 4K pages rather than segments.

32-bit application, OS/2 2.0 looks like a fairly pure implementation of the paged flat model. All of the application's code and data live in a single large segment, and all entry points to the operating system are available as near calls within the same segment. A 32-bit OS/2 2.0 application never needs to be aware of segments and never has occasion explicitly to load a segment register. (Segment registers *do* get loaded behind the scenes, however, whenever the application calls an API function that requires a switch in privilege levels.)

From the point of view of a 16-bit OS/2 1.x application or device driver running under OS/2 2.0, the environment looks as segmented as ever. OS/2 2.0 still provides 16-bit applications with an OS/2 1.x-compatible set of 16-bit API entry points that must be passed far pointers and are entered through far calls. The new operating system passes 80286-style far pointers to 16-bit device drivers regardless of whether the I/O request originated in a 16-bit or in a 32-bit application. OS/2 2.0 even supports a global information segment that are compatible with OS/2 1.x, and it somehow contrives

to keep them meaningful in a system designed for 32-bit applications.

The mind boggles at the contortions the OS/2 2.0 kernel must go through simultaneously to support multiple DOS applications in Virtual 86 Mode, multiple 16-bit protected-mode applications, and multiple 32-bit flat-model applications. The system can assume a different personality on each context switch. Moreover, it handles transformations between flat model (0:32) addresses and 80286-style selector-offset (16:16) pairs in a transparent manner, so 16-bit applications can call 32-bit APIs and 32-bit applications can call 16-bit APIs. Whenever I get a little impatient with the performance of the beta release of OS/2 2.0, I have to pinch myself and remember how astounding it is that so complex a system can work at all.

THE IN-BOX

Please send your questions, comments, and suggestions to me at any of the following e-mail addresses:

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by
William S. Hall

Windows

EXECUTING WINDOWS

Ben Wolff of Amarillo, Texas, poses some questions that many users of *Microsoft Windows/386* have asked: "What is the difference between *WIN386.EXE* and *WIN86.EXE*? Why can I run multiple copies of *WIN86* but not of *WIN386*, and how does *MSDOS.EXE* fit into this?"

A comparison with *Windows/286* may help. In this case you run *Windows* from DOS using *WIN.COM*. When *WIN.COM* starts, it displays the *Windows* logo and then loads *Windows*. During this process *MSDOS.EXE* is executed and becomes the first *Windows* application. *MS-DOS* acts as the command shell for *Windows* and is used to manipulate files and run other programs. One program you can execute from *MS-DOS* is *WIN.COM* itself, but now instead of loading *Windows* again, another instance of *MS-DOS* is created. You can get the same effect by executing *MSDOS.EXE* from *Windows*.

In *Windows/386*, *WIN86.COM* plays the same role as *WIN.COM*. From DOS, you can run *WIN86*. What you get is just *Windows/286*. The only piece missing is the *Windows/286* standard application support. Even that can be supplied if you replace the *Windows/386* versions of *WINOLDAP.MOD* and *WINOLDAP.GRB* with the corresponding 286 versions.

What differentiates *Windows/386* from *Windows/286* is the former's use of the Virtual 8086 (V86) mode of the 80386. As you may know, V86 mode can be used to create multiple 8086-based operating systems running under a protected-mode supervisory program. *WIN386.EXE* loads the *WIN386.386* supervisor program, creates and manages expanded memory, and eventually executes *WIN86.COM*. At that point, you have an 8086 virtual machine running the equivalent of *Windows/286*. Because only one supervisor can be present, *WIN386* can be executed only once. You can run *WIN86* again, but as in *Windows/286*, you will just get another instance of *MS-DOS*.

■ **EXECUTING WINDOWS:** Differentiating among *Windows*' various executable files.

■ **WINDOWS' MEMORY USAGE:** Understanding *Windows*' use of expanded memory.

■ **RAMDRIVE AND SMARTDRIVE:** A look at two programs that speed operations in *Windows*.

For some additional insight into the role of *WIN386.EXE*, you may want to try an experiment. In your *Windows/386* directory, copy *WIN86.COM* to *WIN.COM*. Copy *COMMAND.COM* to *WIN86.COM*. Now execute *WIN386.COM*. When the DOS prompt returns, you will be in virtual 8086 mode with an expanded memory manager. If you now type *WIN*, you will find yourself in *Windows*. This technique is used by programmers to run the *Windows* version of the CodeView debugger, which must be started from DOS and requires expanded memory to run.

Once you have run *WIN386* to get into V86 mode as described above, you could even switch to your *Windows/286* directory and run *Windows* from there. You'll also find that you have expanded memory (pull down the About box to see how much). However, don't expect standard application support to work as it does in *Windows/386*. In fact, after you have experimented a bit, you should be sure to return to your original configuration.

WINDOWS' MEMORY USAGE

Contributing editor Barry Simon recently sent me the following tip on *Windows* memory switches:

"Ironically, with *Windows 2.x*, you may get out of memory errors because you

have LIM EMS 4.0 memory available! If you have such memory available below 640K, then by default, *Windows* will use a large page-frame model. *Windows/386* always has such memory available. You can have this same memory available under *Windows/286* if you run it on a 386 machine with QEMM-386 or 386MAX, and you'll have it with a true LIM EMS 4.0 hardware board.

"With the large page-frame model, *Windows* divides conventional memory into two pieces, the page frame and the rest. The page frame consists of EMS memory that can be swapped in and out. The remainder is not swapped out and is needed for some special-purpose items such as printer drivers.

"When you want to run many applications, a large swappable region can be good, but with even one application you can run out of room in the nonswappable region if it is too small. If you get an 'Out of Memory' message even when using only a single application, you may want to experiment with two command-line switches when you load *Windows*.

`win /n`

loads *Windows* with no EMS support for the *Windows* kernel, so it disables the large page-frame model.

`win /L+40`

loads *Windows* with a large page frame 40K smaller than the default. The number 40 can be changed to other possibilities like +20 and +80.

"There is no magic formula for figuring out which switch is best—only experimenting with your setup can help."

What Simon writes is true—only experimentation will help you find something close to your needs. To add to this confusion, machine architecture, CPU design, and history have conspired to produce a muddled picture of memory layout, usage, and options in today's PC. The situ-

Windows

ation is not helped by terms such as extended, expanded, and expansion memory, which simply sound too much alike to be informative. And, although *Windows* comes with several MS-DOS device drivers designed to help you use your computer's extra memory, their functionality has not always been made clear.

However, making intelligent choices in memory hardware and software configuration can result in significant performance improvements, especially with a memory-hungry program such as *Windows*. So it pays to take a closer look at this matter.

In most machines, there are unused areas in the range between the end of conventional memory and the beginning of extended memory (if any is installed). The technique of using one or more of these gaps as a window into a memory bank is the basis for expanded memory. Since the window lies within the 8086's address range, it becomes possible to provide memory beyond the 640K limit for 8086-, as well as for 80286- and 80386-based machines operating in real mode. Special hardware such as Intel's Above Board and AST's Rampage card along with the supporting software are usually required to use expanded memory. However, like almost every other statement we'll make in this column, there are exceptions. In particular, there are some software packages, including *Windows/386* itself, that are able to emulate expanded memory in extended memory.

Expanded memory is sometimes called banked memory, and the term is a good one. Imagine a row of 64K memory blocks on a board. According to settings on the board, one of these blocks appears at an address below 1MB but above the installed conventional memory. By switching the hardware on the board under software control, another memory block can be made to appear in this same memory space. In this way, a program that knows how to use expanded memory can store data and even execute code in one of these blocks.

In a multitasking environment like *Windows*, each task can be partially or fully loaded into a block, and the scheduler can then switch to the appropriate block as the task becomes active. In this way, even an 8086 processor can see, albeit through a small window, quite a large amount of memory. The Above Board, for example,

holds up to 4MB of memory, and it is possible to have several such boards in a single machine.

It is important to understand that expanded and extended memory do not conflict if different hardware is used for each. It is possible to have a full complement of extended memory and as much as 32MB of expanded memory. The reason is, of course, that expanded memory does not lie in any particular address space until a block is activated. Even so, expanded memory is addressed below the beginning of extended, so the two do not conflict. Of course, if you are using a software package to emulate expanded memory in extended memory, then some of the latter will be reduced.

Understanding expanded memory is complicated by the fact that there are two standards for its control. One is called LIM (Lotus-Intel-Microsoft) EMS (Expanded Memory Specification) 4.0 and the other

**Machine architecture,
CPU design, and
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LIM EMS 3.2. Although LIM EMS 3.2 is a subset of 4.0, there are some differences that could affect how *Windows* uses this kind of memory. Basically, in order for 3.2 to work, the supporting software must be able to locate four 16K (64K total) contiguous blocks of unused memory space. Usually this area is found above the video address space but below system ROM.

Sometimes it can be difficult to find a contiguous 64K block because of supplemental ROMs, LAN cards, and so forth. Often there may be additional free areas smaller than 64K that would go unused under 3.2. LIM 4.0 removes some of these restrictions, since up to 256 16K blocks are permitted, and they do *not* have to be contiguous. If you are still using LIM 3.2, it's time to upgrade your software.

SUPPORT FOR EXPANDED MEMORY

From its 1.0 days, *Windows* has included EMS (expanded memory) support for the Intel Above Board by distributing a form of the required software driver EMM.SYS on the *Windows* disks. In *Windows* 2.0, the AST Rampage board was added (REMM.SYS) along with AST's special memory board designed for the AT&T 6300 Plus (AEMM.SYS). Finally, PS2EMM.SYS was provided for the IBM PS2 expanded memory board. If you use *Windows* and these boards, you should be using the *Windows*-supplied version of the drivers.

Four README files with the same names as the drivers but with the extension .TXT explain quite clearly how to install the software. In particular there are notes about how to select the page frame (the window into the memory) and how to avoid conflict with networks.

You do need to be careful when using expanded memory and *Windows/386*. For example, take the following letter from Joel Bryant of Boston, Massachusetts:

"Why can't I get Windows/386 to work with my AST expanded memory board? I never had any trouble until I tried to switch to Windows/386."

The answer is simple. If you use an expanded memory board on a 386 machine, you may not be able to run *Windows/386*, because *Windows/386* emulates expanded memory in extended memory. *Windows/386* probably will not function correctly if expanded-memory hardware and the appropriate driver are installed. Therefore, it's highly recommended that such memory be converted to extended memory, if possible. For example, the AST and the Above Board both allow you to distribute memory between the two modes in a fairly arbitrary manner.

This may make it inconvenient, however, when you are not running *Windows*. You may want to consider creating different CONFIG.SYS files to match the needs of the various environments under which you operate your system.

There is another unpleasant surprise for which you should be prepared. Memory boards usually provide slow, 16-bit memory; the 80386 would much rather see fast, 32-bit memory. If converted to extended memory, the 16-bit memory will perform much more slowly.

Windows itself will perform about the same, since it runs in the first 1MB of memory where the memory is 32 bits wide. But if you then start running old ap-

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Windows

plications, however, some of them may end up in your 16-bit extended memory. It can be quite a performance hit. When I first got my Zenith Z-386, it had only 1MB of memory. I added 4MB using my Intel Above Board, but the speed of processing dropped by a factor of nearly four for old applications! I strongly suggest that you retire such boards or leave them in 80286 or 8086 machines.

Windows/386 will give you expanded memory from your fast 32-bit memory if you use it as a basic control program. Again, however, this solution may not be adequate; for example, the amount of memory space provided for standard applications that can be executed is less than you would have available directly under DOS. It has been a source of some frustration to me that I can't always use the tool I need most under *Windows/386*, the Microsoft C compiler. We all hope that in the future *Windows* will become a true operating environment capable of supporting both DOS and *Windows* without having to leave one for the other.

RAMDRIVE AND SMARTDRIVE

If you are an experienced *Windows* user, you know that *Windows* moves, discards, and reloads program segments according to the demands of the moment. You're also aware that *Windows* may create numerous temporary files both for *Windows* applications and for storage of memory and screen images of standard applications during context switching between them and *Windows*. *Windows*' performance improves greatly if these activities can be made from memory rather than from disk.

This is the programmer's answer for Bob Vox of Canton, Ohio, who wants to know about the importance and use of RAMDrive and SMARTDrive:

"Windows comes with two programs called SMARTDrive and RAMDrive. I'm not sure exactly why Windows needs these programs. I have to support several computers on which Windows is run and I would appreciate any information you can shed about them, as well as on how they might affect our use of Windows."

Let's take a closer look at the two programs. RAMDrive and SMARTDrive, each with a separate purpose, can help you take full advantage of extra extended or expanded memory to increase the speed of

operations in *Windows* and in MS-DOS itself.

RAMDRIVE.SYS is an MS-DOS device driver that has been offered as part of the *Windows* package since its beginning. Capable of creating a virtual disk drive in

**SMARTDRV.SYS is
one of the most useful
programs supplied by
Windows. I am always
surprised by the
number of experienced
users who know about
it but don't use it.**

any kind of memory, RAMDRIVE.SYS can be used to replace the traditional VDISK.SYS that comes with MS-DOS. RAMDrive is documented in the file RAMDRIVE.TXT supplied on the *Windows* distribution disk. Although recent versions of this file are more accurate, older versions of *Windows* 2.0 omitted the fact that RAMDrive can also use expanded memory. In addition, its use with the AT&T 6300 PLUS was confused with the Olivetti M28, causing further confusion. If you think that your documentation is suspect, perhaps you should try to obtain the latest version.

RAMDrive is installed by placing the appropriate DEVICE= line into CONFIG.SYS. More than one RAMDrive can be used. The options are too numerous to describe here, but basically, you must choose where the RAM disk will reside: in conventional (not recommended), expanded, or extended memory; and the size, block size, and number of entries in the root directory. The latter two can be defaulted if you expect only temporary files to be created there. However, if you plan to store programs as well, then you may need to increase the number of root directory entries above the default value of 64.

Whether you place RAMDrive in extended or expanded memory depends on a lot of factors, including the processor and the version of *Windows* (i286 or i386) you

are running. As a general rule, you should use extended memory if enough is available. As for the size, try at least 1MB if you use a lot of standard applications. But even a small RAMDrive can help you. And, don't forget to set two environment variables in your AUTOEXEC.BAT file. For example, if drive E: is the RAM disk, include the following:

```
set temp=e:\  
set tmp=e:\
```

Different MS-DOS programs use different environment variables. These are the most common but are by no means universal.

SMARTDRV.SYS requires much less thinking to use. It is also one of the most useful of all the supplementary programs supplied by *Windows*. SMARTDrive is a disk caching program that keeps the most recently accessed portions of the disk in memory. Once installed, it works quietly in the background. SMARTDrive is not only useful in *Windows* but in DOS as well. I am always surprised, however, by the number of experienced *Windows* users and developers who know about SMARTDrive but don't use it. I can always tell if one of my colleagues has not installed it by the amount of disk activity; a compile of a *Windows* program is almost completely devoid of disk activity when the driver is present and completes noticeably faster.

The installation of SMARTDrive is described adequately in the *Windows* manual. You'll have to make the same choices as for RAMDrive concerning which kind and how much memory to use, but these are the only decisions. SMARTDrive is also *Windows*-aware; if placed in expanded memory, the amount of space used for disk caching is adjusted according to the demands for memory.

You can see the effects of SMARTDrive as follows. Run a large program such as GW-BASIC from DOS and note the time it takes to load. Then exit and run it again. The program will load recognizably faster.

OPENING WINDOWS

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Relational reporting	(100)	()	Excellent	Very Good	Very Good	Very Good	Excellent	Excellent	Excellent
Programming language	(100)	()	Excellent	Good	Excellent	Excellent	Satisfactory	Excellent	Excellent
Speed of relational operations	(125)	()	Very Good	Satisfactory	Good	Very Good	Good	Excellent	Very Good
Documentation	(100)	()	Very Good	Poor	Excellent	Very Good	Very Good	Excellent	Satisfactory
Ease of learning	(50)	()	Excellent	Unacceptable	Satisfactory	Satisfactory	Very Good	Very Good	Very Good
Ease of use	(125)	()	Excellent	Good	Very Good	Satisfactory	Very Good	Very Good	Excellent
Error handling	(100)	()	Good	Poor	Satisfactory	Very Good	Very Good	9.5	8.8
Support	(25)	()	Good	Poor	Very Good	7.7	7.8		
Support policies	(50)	()	Good	Poor	Very Good				
Technical support	(75)	()	Excellent						
Value			9.0	4.0					
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Use your own weightings to calculate your score									

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edited by
Trudy Neuhaus

Databases

In the May 31, 1990, issue, I presented PARAVIEW, a utility for viewing *Paradox* files. Criss Laidlaw from Shelburne, Vermont, submitted a similar idea, only it's for *dBASE* files. Laidlaw writes:

I've written a C program called DBLOOK that lets you examine dBASE files without running or even owning dBASE. It displays the header and data (but not the memo fields) of dBASE data files. The program outputs the data in a format that's almost identical to the dBASE LIST STRUCTURE command. And, of course, it's significantly faster than dBASE.

The program demonstrates how you can read a dBASE file from any C program. You can incorporate the dbdata function into almost any application and construct programs that generate reports from dBASE files or convert a database to another format. In order to run this program, enter

```
DBLOOK filename [options]
```

where filename is the name of a dBASE database file (the .DBF extension is not required). The possible options are /f and /d; they will let you display the field information or the data.

DBLOOK is dual-purpose: it's a handy *dBASE* file viewer and a valuable piece of code for anyone interfacing C programs to their *dBASE* applications. For the sake of discussion, let's say you're tired of waiting for the *dBASE* report generator to print out a particular report. You decide that a custom-written C program may be just what you need to speed up report generation. Such a program must first read the *dBASE* database file structure, just as DBLOOK does.

The program was modified so that it will read *dBASE IV* files by splitting the version member of the header structure into bit fields. *dBASE IV* reserves the additional bits of the version byte for use by its SQL and memo-field components.

This program is so vanilla that it should

■ **EASY ACCESS VS. SECURITY:** Some readers want an easy way to view a file; others want to make it difficult. Here are strategies for both camps.

compile with nearly every C compiler, making it available to most C and *dBASE* developers. Unfortunately, there isn't enough room to print the code listing in this column. However, it is available for downloading from PC MagNet. See the "By Modem" sidebar in the Utilities column for downloading instructions. And remember, you don't have to be a member of CompuServe to download these programs.

If you don't have a modem, you can receive the source code by mail or fax by sending a *postcard* with your name, address and fax number (if applicable), to Databases, *PC Magazine*, One Park Avenue, New York, NY 10016; Attention: Katherine West. No phone calls, please.

THE FLIP SIDE

Although PARAVIEW and DBLOOK may prove handy tools for many of you, there seem to be quite a few of you who are interested in just the opposite: making it impossible for your database files to be viewed. And you spend many an hour trying to develop various security techniques and schemes that will prevent, and at the very least deter, potential snoopers from accessing your files. Tim Breneman of Mason City, Iowa, writes:

In your January 16, 1990, issue, Kevin Owens suggested "encrypting" files by writing an X to the 15th byte of the dBASE file header. But as you noted, although this "encrypts" dBASE III and IV files, FoxBASE and Clipper can still access these files.

A better way to keep anyone from look-

ing at a dBASE III-compatible database file is to change the very first byte of the file. A dBASE III-compatible database file starts with a 03h byte if it has no memo fields or with an 83h byte if it does have a memo field. If you change this byte to a 1Ah, you will receive a "Not a database file" error message when you try to use it, effectively locking it out to the casual user. In addition, since DOS interprets 1Ah as an End-Of-File marker, snoopers won't be able to look at the database file with the TYPE command, either.

The resultant ENCRYPT.SCR file would look like this:

```
A
DB 1A

W
Q
```

And the UNCRYPT.SCR file would look like this:

```
A
DB 03 (or 83 if it had a memo field)

W
Q
```

*Incidentally, if you have a database that has a memo field in it and you have lost the *.DBT file, use the 03h variation of the UNCRYPT.SCR file to make dBASE "forget" it needs that file to run.*

Although this is similar to the one Owens submitted (it requires changing only one byte in the header), it is a better approach.

Using Owens's approach, attempting to access a file produces a "Database is encrypted" response, so the snooper knows he's on the right track and needs only to work on unencrypting the file. Using Breneman's method, on the other hand, the response is "Not a database file." And if you rename the .DBF file to some other ending (using a batch file that also calls ENCRYPT.SCR), the snooper will be

Databases

even more easily discouraged. (Note: If a memo field is present in a *dBASE III* file, the first byte is 83h. However, *dBASE IV* uses a different memo field format, so the first byte is 8Bh. If you're using *dBASE IV*, you'll need to change the UNCRYPT script above.)

As Breneman also points out, placing 1Ah at the file's beginning disables the DOS TYPE command's ability to dump the file to screen or printer.

If you use *Clipper* to access the encrypted file, you won't get the "Not a database file" error. However, the encryption is completely successful: *Clipper* won't access the file in any way. When such a file is USED in *Clipper*, its debugger reports

```
EOF() and BOF() are both TRUE
RECCOUNT() is 0 (file has no
records)
FCOUNT() is 0 (file has no fields)
```

But nothing is foolproof. While some methods of looking at a file will fail, others will succeed. Since data is still physically on the hard disk, it can be viewed using programs such as *The Norton Utilities* and *DBLOOK* (presented above). And in the case of *Clipper*, the marketplace now provides a variety of tools that repair damaged database files, and these tools can certainly "repair" this "damage."

Kenneth E. Madl of Denver, Colorado, prefers to take the password approach to security and writes:

A while back, you printed a dBASE password program. While it was helpful, I prefer not to hard-code passwords into my programs, both for security and for ease in changing the password later. Instead, I use a DOS environment variable as the password. This is how it works.

First, choose a password. It should never be a real word, so as a trivial example let's use ASDF, the first four letters of the middle row on a standard keyboard. Then define the ASCII values for each letter; in this case it's 65, 83, 68, and 70. Next, take the first four letters of an arbitrary phrase embedded in the program; in this instance the one defined by Title1, SECU, with it's resulting ASCII values of 83, 69, 67, and 85. Add the corresponding values of each group together (65 + 83; 83 + 69; and so on), and subtract a constant value from the total—let's use 64 for this

example. The result is 84, 88, 71, and 91, or TXG[. Note: the value of the constant should not be greater than 66, in order to avoid errors in the SET command caused by arithmetic operators. The program then instructs you to put SET PASS=TXG[in your AUTOEXEC.BAT file and enter it on the DOS command line. This section of the program can be run in either dBASE III or Clipper.

Although Madl succeeds in his effort not to hard-code the password, he still gives away too much information in his program.

To avoid leaving a trail the snooper can follow, you should use a less descriptive name than PASS as the DOS environment memory variable. Instead of SETting the DOS environment memory variable in the AUTOEXEC.BAT file, have the user enter it by hand from DOS before he begins the *dBASE* session. (Although this is more of a hassle to use, it's a far more sophisticated password system.) And last, be careful not to include lines such as

```
IF NoSet
Msg = "Enter SET PASS=" + NewWord
+ " on DOS Command Line"; + " & in
AUTOEXEC.BAT"
```

which informs the user to study the AUTOEXEC's SET PASS= parameter for further clues.

I've taken the liberty of having Madl's program streamlined to a simpler and shorter program. The new program, SECURITY, is shown in Figure 1 and doesn't use the memory variable constant—it simply uses 64.

Ultimately, there is no simple way to prevent a determined, skilled snooper from penetrating a .PRG or .DBF file. Even DELETing them from your hard disk isn't a guarantee, since DEL changes only one byte in the FAT. You need to use a program like *The Norton Utilities WIPE-FILE* (or Neil Rubenking's *WIPE.BAT*, in the November 15, 1988, issue) to actually remove (that is, overwrite) the physical data from the disk.

SECURITY SUGGESTIONS

Given this, perhaps deception and camouflage are better protection than strong programming techniques. So for you security-conscious readers, here are some general tips:

- Don't allow the snooper to read the .PRG coding. Compiled programs like *Clipper* or *Quicksilver* are perfect for this: their .EXE files don't require the .PRG files to be present. Users of interpretive programs like *dBASE* and *FoxBASE* can pseudo-compile their programs so that the actual .PRG files can be removed from the disk (*dBASE III Plus* uses *DBCODING.EXE*, *FoxBASE* uses *FOXCOMP.EXE*, *dBASE*



Figure 1: This security program uses a DOS environment variable as the password.

Databases

IV uses the **COMPILE** command). These pseudocompilers produce symbolic representations of the program code, so they're not nearly as secure as a *Clipper* executable, but they're better than nothing.

■ A simple encrypting technique is to make a file “disappear” from the DOS directory. Using the ASCII character 255 which DOS shows as a blank, offers the easiest way to do this. If you incorporate this character at the beginning or in the middle of a filename, it appears as a space. However, if it's the last character of a filename, the filename will appear perfectly ordinary and yet someone won't be able to USE it. You could also name a file with this character. But, unfortunately, a DIR command will still show the date and time stamps. Alternatively, a whole set of files can be hidden in a subdirectory named with the ASCII character 255.

■ DOS's ATTRIB command can be used to hide a file—from DOS as well as from the DIR command in *dBASE*, *FoxBASE*, and *Clipper*. However, these programs

will still USE a hidden file.

■ Perhaps the best idea is to have the program check for the existence of an extra or extraneous file. If this file isn't present, the program won't run. The beauty of this technique is that, while it's inconvenient to remove and recopy a large database every time you need it, it's easy to copy or create an empty file. You could copy this file onto your computer each day (or create it with COPY CON or rename it) and then delete (or rename) it when you're done.

There's no need for this file even to be located on the same drive or subdirectory as the sensitive data and programs. In fact, it's better buried in some innocuous subdirectory like \UTILS, given some uninteresting filename like OLDREPORT .NOT, and carry some unrelated date like 11/4/88.

For programmers who need to protect against nonpayers, this same innocuous-looking file might hold a date that the programmer changes when payment is received. If not changed, the program will be disabled beyond a certain date.

The more invisible a security system, the harder it will be to penetrate, so camouflage the ability to enter a password. For

example, let the program load as far as the Main Menu where the standard choices are presented. If the user hits a certain (non-standard) key here (which isn't prompted on the menu, of course), the program branches to SECURITY.PRG for password entry.

No doubt the Pentagon has more powerful ways to secure sensitive data (and there are a few commercial TSR's that encrypt and decrypt—or at least pack and unpack—on the fly), but a combination of the above techniques will foil all but the most resourceful and skilled opponent.

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Research for this article was provided by Richard Hale Shaw, a contributing editor of PC Magazine, and Brad Stark, a frequent contributor of PC Magazine.

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by
Craig Stinson

Spreadsheets

REVERTING TO THE DEFAULT DIRECTORY

I often use Lotus 1-2-3's /File Directory command to change the default directory temporarily. But many times I need to return to the original default directory later in the 1-2-3 session. Unfortunately, 1-2-3 does not have a /File Directory Reset command. So to revert to the original default directory, you must issue the /File Directory command and type the name of the original default directory.

But I found a way to simplify this process. I discovered that 1-2-3 reserves the 49th through 116th bytes in the 123.CNF file for the specification of the original default directory. The last character of the name of the directory is followed by an ASCII 0. For example, in a 123.CNF file that specifies C:\123\WORKSHEETS as the startup directory, the 49th through 65th bytes are

```
C : \ 1 2 3 \ W O R K S H E E T S
```

The 66th byte is an ASCII 0.

After determining where the name of the default directory is stored, I developed a macro that extracts that name, issues the /File Directory command, and specifies that name as the new default directory. This macro is shown in Figure 1.

The first statement in this macro instructs 1-2-3 to open 123.CNF, which is stored in the C:\123 directory. (If your 123.CNF file is stored in a different directory, modify this statement accordingly). If the file exists, 1-2-3 opens it and proceeds to the statements in cells B2..B6. If the file does not exist, 1-2-3 beeps and cancels the execution of the macro.

The second statement moves the file pointer to the 49th byte in the 123.CNF file—the first byte of the name of the start-up directory. At that point, 1-2-3 executes the statement in cell B3, which commands it to read the current byte, as well as the 66 bytes that follow it, into the cell named DIRECTORY (B8). Note that when 1-2-3 imports ASCII 0 into the DIRECTORY, the

■ **REVERTING TO THE DEFAULT DIRECTORY:** Return to your original directory at the touch of a key.

■ **"UNAPPLY" NAMES IN EXCEL:** There is a way to delete range names without having to replace the references by hand.

■ **PROBLEMS WITH /DATA TABLE:** Expect trouble when your data table has formulas that reference the input cell.

character is converted into Lotus International Character Set (LICS) character 153.

The fourth statement sets up a loop that determines the offset of the first LICS 153 in the label in DIRECTORY relative to the beginning of that label. (This character marks the end of the name of the default directory). During each pass through the loop, the statement in cell B12 examines a different character in the string starting with the first character. If the character is not an LICS 153, 1-2-3 increases the value of COUNT (B10) by 1 and begins another pass. When

1-2-3 finds the first LICS 153, it breaks out of the loop. At this point, the value of COUNT is the number of characters in the directory name. Consequently, the statement in cell B5 reduces the label in DIRECTORY to the name of the default directory.

Finally, 1-2-3 executes the statement in cell B6, which commands it to issue the /File Directory command, type the characters stored in DIRECTORY (at this point, the name of the original default directory), and press Enter. This makes the original default directory the default directory once again. Since cell B7 is blank, 1-2-3 closes the open file and ends the macro.

Mark Sullivan
Chicago, Illinois



Mr. Sullivan's clever macro works as described, and it is useful in situations where you've used the /Worksheet Global Default Directory command—instead of the /File Directory command—to change the default directory. Note, however, that if you issued the /Worksheet Global Default Update command after using the /Worksheet Global Default Directory command to change the default directory, 1-2-3 will have written the name of the new default directory to the 123.CNF file. Consequently, 1-2-3 will make that directory—not the original default directory—the current directory.

In some cases, there is an easier way to

DEFAULT DIRECTORY MACRO						
	A	B	C	D	E	F
1	\d	{Open "c:\123\123.cnf","R"}{Beep}{Quit}				
2		{SetPos 48}				
3		{Read 67,DIRECTORY}				
4		{For COUNT,0,66,1,LOOP}				
5		{Let DIRECTORY,@LEFT(DIRECTORY,COUNT)}				
6		/fd{DIRECTORY}				
7						
8	DIRECTORY					
9						
10	COUNT					
11						
12	LOOP	{If @CODE(@MID(DIRECTORY,COUNT,1))=153}{ForBreak}				
13						

Figure 1: This macro manipulates the 123.CNF file, so that you can quickly return to your original default directory once you have changed it temporarily.

Spreadsheets

return to the original default directory. If you used the /File Directory command (rather than /Worksheet Global Default Directory) to change the default directory, you can revert to the default simply by issuing the /Worksheet Global Default Directory command and pressing Enter.

This simpler method works here because the /File Directory command doesn't change the default directory; it overrides it. Consequently, when you issue the /Worksheet Global Default Directory command after using the /File Directory command, 1-2-3 will list the name of the original default directory—not the one you specified when you issued the /File Directory command. Pressing Enter respecifies the original default directory, cancelling the effect of the /File Directory command.

"UNAPPLY" NAMES IN EXCEL

Microsoft Excel doesn't automatically replace cell coordinates with their range names. You have to replace each occurrence using the Apply Names command. For example, if the range A1:A10 is named VALUES and cell A12 contains the function =SUM(A1:A10), you must issue the Apply Names command, select the name VALUES, and click OK. Then the formula in A12 would read =SUM(VALUES).

Unfortunately, if you subsequently delete the range name VALUES, the formula does not automatically revert to SUM(A1:A10); instead Excel returns the error value #NAME?. And worse yet, there isn't even an "Unapply Names" command that would replace all occurrences of the range name you want to delete with the coordinates of the range.

The solution is to use Replace. (To unapply the name from every formula in the worksheet, select only a single cell.) First pull down the Formula menu. Then choose Replace, type the range name into the "Replace:" text box, type the coordinates of the range name into the "With:" text box, make

sure the Part option is selected, and use the Find Next and Replace buttons to replace all occurrences of the range name.

Once Excel has reinstated the cell references, you can then safely delete the range name.

John Martin
Atlanta, Georgia



It's frustrating that Excel doesn't automatically apply defined range names to formulas the way most other spreadsheet programs do. It's even more frustrating that it doesn't automatically "unapply" the names when the definitions are deleted. But in the first case, there appears to be a reason for the unaccommodating behavior.

Excel's Apply Names command has an option that lets you apply two names to a given cell—one derived from the text at the top of the cell's column, the other from the text at the left side of the column's row. For example, if the cell is in a column headed January and a row headed Profit, Excel's Apply Names command can automatically name the cell "January Profit."

To see how this is done, take a look at the miniworksheet in Figure 2. The first thing you would do after setting up this matrix is select the whole thing—A1:D4. Then pull down Excel's Formula menu, choose Create Names, check the Top Row and Left Column checkboxes, and click OK. This command causes Excel to create the following names:

Name	Refers to
Sales	\$B\$2:\$D\$2
COGS	\$B\$3:\$D\$3
Profit	\$B\$4:\$D\$4
January	\$B\$2:\$B\$4
February	\$C\$2:\$C\$4
March	\$D\$2:\$D\$4

Now comes the good part. With the range still selected, pull down the Formula menu and choose Apply Names. In the dialog box, select all six names—Sales, COGS, Profit, January, February, and March. (To select more than one name at a time, hold

down the Ctrl key while you click each name in turn.) Still in the Apply Names dialog box, make sure that the check boxes next to Ignore Relative/Absolute and Use Row and Column Names are checked.

Now click the Options>> button. Excel responds by adding some more check boxes and radio buttons at the bottom of the dialog box. Remove the checks from the boxes next to Omit Column Name If Same Column and Omit Row Name If Same Row. In the Name Order radio-button group, click Column Row. Now click the OK button.

At this point, your Profit formulas in B4:D4 have nice descriptive names. B4 reads January Sales-January COGS, C4 says February Sales-February COGS, and so on.

It's because Excel gives you the option to apply intersecting names based on row and column headings that it doesn't automatically apply names the way Lotus 1-2-3 and other programs do. On the other hand, there's no apparent reason why Excel doesn't "unapply" the names if you delete their definitions.

PROBLEMS WITH /DATA TABLE

I recently encountered a situation in which Lotus 1-2-3's /Data Table command did not return the correct results. In calculating the monthly payment for a \$100,000, 12 percent Annual Percentage Rate (APR), 30-year loan, I entered the values 100000, .12, and 30 into cells B1, B2, and B3, then entered the function

`@PMT(B1,B2/12,B3*12)`

After making these entries, I realized that I also needed to calculate the payment at 10, 11, 13, and 14 percent APRs. To do this, I entered the formulas

A6: +B2-.02
A7: +B2-.01
A8: +B2+.01
A9: +B2+.02

into cells A6..A9. Then, I issued the /Data Table 1 command, and identified cells A5..B9 as the Table range and cell B2 as the input cell. Figure 1 shows the results.

Unfortunately, only the value in cell B6 is correct. Cell B7 should contain 952.32 instead of 804.62 cell B8 should contain 1106.20 instead of 877.57 and cell B9 should contain 1184.87 instead of 1028.61.

J. A. Harris
Los Angeles, California

APPLY 2 NAMES TO ONE CELL			
	A	B	C
1	January	February	March
2	Sales	12345	12789
3	COGS	9812	8981
4	Profit	3333	3888

Figure 2: This sample data is used to illustrate the Excel option to apply 2 names to one cell. For example, you can name cell A2 "January Sale," cell B2 "February Sales," and so on.

Spreadsheets



The formulas in cells A7..A9 of Mr. Harris's worksheet cause the /Data Table command to fail. In most cases, the leftmost column of a one-way data table (and both the leftmost column and topmost row of a two-way data table) will contain values although they may contain formulas. However, if the formulas reference the input cell(s), either directly or indirectly, the /Data Table command returns incorrect results.

When 1-2-3 executes the /Data Table command in Mr. Harris's example, it substitutes the results of the formulas in cells A6..A9 into cell B2 one at a time. After each substitution, 1-2-3 recalculates the entire worksheet and places the result of the function in cell B5 into the appropriate cell of the second column of the table. Since the formulas in cells A6..A9 reference the input cell (B2), their results change after each substitution. Thus, 1-2-3 substitutes the updated—rather than the original—results of these formulas into the input cell. And consequently, the results that 1-2-3 enters into the right-hand column of the table are not based on the original values of the formulas in the left-hand column of the table. For example, the value substituted from formula in A7 is the result not of $+B2-.01$ but rather of $(+B2-.02)-.01$. So for the purpose of the input cell the formulas in A6..A9 become *effectively*

A6: $+B2-.02$

A7: $(+B2-.02)-.01$

A8: $((+B2-.02)-.01)+.01$

A9: $((+B2-.02)-.01)+.01)+.02$

And the Payment table is based on 10, 9, 10, and 12 percents rather than the expected 10, 11, 13, and 14 percents.

In order to avoid this problem, you should not use formulas that reference the input cell as entries in the leftmost column of a one-way data table, or in either the leftmost column or top row of a two-way data table. If you want to substitute the results of formulas into the input cell, you should use the /Range Values command to replace those formulas with their current values prior to executing the /Data Table command.

This same problem occurs in many other spreadsheet programs, including *Symphony* and *Excel*.

SAMPLE DATA ON PAYMENTS		
	A	B
1	Principal:	\$100,000
2	Rate:	12.00%
3	Term:	30
4		
5	Payment:	\$1,028.61
6	10.00%	\$877.57
7	11.00%	\$884.62
8	13.00%	\$877.57
9	14.00%	\$1,028.61
10		

Figure 3: This sample worksheet shows the monthly payments on a 30-year, \$100,000 loan when different APR's are used. The results of the rates in A6..A9 are incorrect, because the rates are formulas rather than values.

CORRECTION

In the February 27, 1990, *Spreadsheets* column, R. A. McCormack offered a clever tip for commenting formulas in *Lotus 1-2-3*, Release 2.2. Mr. McCormack's helpful idea was simply to append text to the end of a numeric constant or formula by enclosing the comment in quotes, as follows:

`6000+"January sales"`

Because the text strings are evaluated as zeros, the inclusion of comments doesn't affect the outcome of the formula. You can even put the appended text enclosed in quotes at the beginning of a formula or numeric constant, like this:

`+"January sales: "+6000`

or anywhere within, like this:

`6000+"January sales"
+7000+"February sales"`

I replied—in error—that this technique would not work in Release 2.01 and could cause compatibility problems in businesses that use both Release 2.2 and Release 2.01. In fact, the technique works just fine in Release 2.01 but not in Release 2.0 or *Symphony 2.0*.

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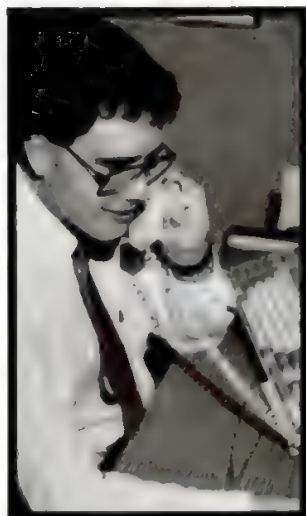
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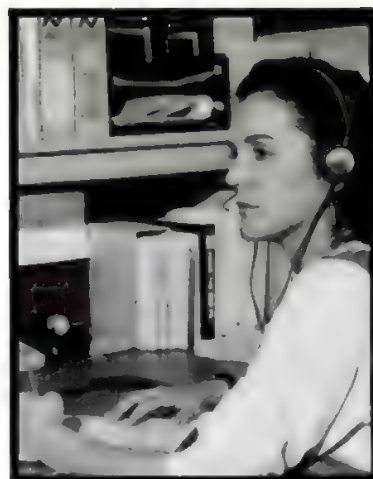
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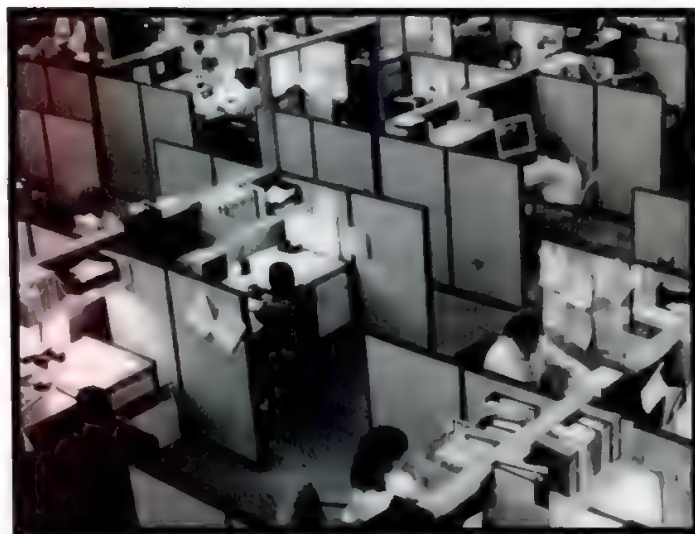


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by
Craig L. Stark

The Working Word

ENHANCING WORDPERFECT

Occasionally, a reader submission comes along that contains not one, but a whole multitude of solid productivity tips. One such submission recently arrived from Mr. Herbert Kay, of West Caldwell, N.J., whose numerous suggestions might collectively be titled, "Tips You Won't Find in Your *WordPerfect* Manual."

MACROS UNLIMITED

Invoking macros by name, using Alt-F10, is a tedious business at best, as the overwhelming popularity of Alt- and Ctrl-key macros attests. A problem arises, however, because the number of desirable functions—some user-specific, others general—that can't be executed directly from *WordPerfect*'s menus exceeds the number of available single-key Alt- and Ctrl-key macros. Mr. Kay notes, however, there is an easy way to expand almost indefinitely the number of macros you can put inside a single keyboard-definition file (.WPK). He writes:

Tucked away in your MACROS.WPK file is an innocuously titled macro identified as Ctrl-G: "Glossary Macro Expand Abbreviation." Its official purpose is to expand an often-used abbreviation into its full form (for example, *fyl* to *for your information*), and several samples are supplied. What the manual doesn't tell you, however, is that the same expansion facility can be used to invoke virtually any kind of macro you choose to create using text and/or formatting codes. The only price you pay is striking just one more key (usually) than you would for a conventional keyboard macro.

Thus, for example, you might use

c ctrl-g

to invoke a "closing" macro for your personal letters (Tab Tab Tab Tab Sincerely Yours, Enter . . .). When you run out of single alphabetical letters, you can expand letter pairs—aa or ab and so on, or numbers. I have found this much more efficient than

■ Create a personal keyboard file containing the best of your own and *WordPerfect*'s keyboard macros.

creating conventional macros that must be invoked by Alt-F10 plus a name or number, and that soon start to clutter your directory with a multitude of .WPM listings.



The principle behind such a series of macros clearly has much in common with the command-oriented approach taken by the *Companion* program I discussed last time. A single macro-activation key—in this case Ctrl-G—is used with a one- or two-letter mnemonic. Note that the mnemonic is typed *before* you hit Ctrl-G; using the conventional *WordPerfect* technique, you'd hit Alt-F10 first and then type in whatever name or number you had given your macro.

In order to use Mr. Kay's approach directly, however, you would have to select MACRO.WPK as your active keyboard, for this is the .WPK (keyboard) file that contains the master Ctrl-G. That may present a problem. Users of Version 5.0 have three *WordPerfect*-supplied sets of keyboard macros, and if you've updated to Version 5.1, you have several more. Chances are that you'll want to use some of the macros from each: perhaps the F1/F3 switch between Cancel and Help, from ALTERNAT.WPK; the Home-key assignment (to perform Home, Home, Home, Left Arrow) from the ENHANCED.WPK; the Ctrl-G and many more of the assignments contained in MACRO.WPK; and a number of the handy SHORTCUT.WPK keyboard macros.

CUSTOMIZED KEYBOARD

It's obviously impractical to go back and forth selecting different keyboards while you're working. The answer is to create

your own .WPK file that will incorporate the group of *WordPerfect*-written macros that meet your needs, assigned to the keys that best suit you. Addressing users of Version 5.0, Mr. Kay writes:

The *WordPerfect* manual describes one way to excerpt individual macros from the MACROS and ENHANCED keyboard files into macro files. If you follow the recommended procedure, however, each transposed macro becomes a separate file. Thus, if YOURFILE.WPK contains 20 transferred macros, there will be 20 .WPM files (for example, ALTA.WPM, ALTB.WPM) cluttering your disk. Fortunately, there is a better way, courtesy of Karen Acerson of *WordPerfect* Corporation:

■ At the main editing screen, type Shift-F1, 6, 4 (to Create), and at the prompt for the name of the keyboard, type in the name you want for your own new combined macro file. Here, let's call it YOURFILE. Then press Enter. Facing you should be the blank menu for YOURFILE.WPK, the target file.

■ Hit F7. You should now see the names of all of the available keyboard-macro files, including YOURFILE.

■ Move the cursor to the keyboard that will be your source file—the one from which you will pull out specific macros, and press 1 to Select it.

■ Now move the cursor to highlight the target file, that is, YOURFILE, and then type 5 for Edit. (Do not Select it.)

■ From the menu that appears, type 4 to Create, and give it a key, for example, Alt-A. (My personal preference, to minimize later confusion, is to use the same key mapping in YOURFILE as in the source file. This may not always be possible, but I'll assume you can do so here.)

■ Press 1 and then enter a short verbal description of the macro. Then type F7.

■ Press 2 (for Action), and then delete whatever shows up in the Action box. Then type Ctrl-V once. The screen will show no change with this keystroke.

■ Still in the Action box, hit the key from the source keyboard that identifies the macro

The Working Word

you want to transpose, for example, Alt-A (if you are using the same key name as on the original). The contents of the Alt-A on the source keyboard will suddenly appear in the Action box of YOURFILE.WPK.

- Hit F7 twice. You now should be in the YOURFILE menu, with Alt-A listed as the first macro in that file.

- Repeat the steps above to transpose the next macro. If you want to create your own macro and add it to YOURFILE, from the main editing screen type Shift-F1, 6, and Select YOURFILE (if it's not already selected as your macro keyboard). Then type 5 to Edit, then 4 to Create, and assign an unused key. Enter a description, go into the Action box and, after deleting anything there, enter the keystrokes and codes of your macro.



In *WordPerfect 5.0* Mr. Kay's procedure works perfectly, but in Version 5.1, as I discovered, you can't make the transposition from the source to the target file in a single, smooth step. WP 5.1 users should start by creating a blank YOURFILE (it's Shift-F1, 5, 4 in Version 5.1) as above. Then:

- Highlight the keyboard source file (you don't have to Select it) and hit 7 to Edit it.

- Move the highlight to the macro you want to copy and pick Option 6 (Save/Macro). You'll be prompted for a name or Alt-key. Supply anything—Alt-A or Smith—to christen the macro file that will now (temporarily) contain the selected macro you want to use in YOURFILE.

- Press F7 to return to the list of keyboard files and move the highlight to YOURFILE (again, don't Select it by pressing 1). Hit 7 to Edit it.

- At the next screen, pick Option 7 (Retrieve). You'll first be prompted for the YOURFILE key onto which you wish to retrieve the macro, and when you've typed that in, you'll be prompted for the name you gave to the saved file from the source keyboard. Supply that, and you'll suddenly see that it is now ensconced in YOURFILE.WPK. After you've backed out of your keyboard construction task, you can delete the temporary file(s) you created.

SAVING SPACE

One major advantage of building your macros into a keyboard file (.WPK) is that it saves hard disk storage space. Keyboard

macros are often less than 100 bytes in length, but each one stored as a separate file requires a full cluster—typically 2,048 types—on your disk. You may easily end up with 20 to 40 keyboard macros before you've got *WordPerfect* working to your liking, and that adds up to the kind of waste that only a government agency would tolerate.

As a further contribution to saving space in ways your manual didn't tell you, Mr. Kay adds the following:

As you've probably discovered, *WordPerfect* files, especially those containing styles, can consume a great deal of space. One way to markedly reduce the length of your saved files is to dispense with open styles and use macros instead.

WordPerfect has never clarified the functional difference between styles and macros. Both can incorporate text and codes. With the exception of being faster to edit repetitions of a given style than those of a macro, I have yet to find a macro that can't do anything an open style can do, and do it in a small fraction of the space. For example, I've had 10K documents incorporating a style shrink to only 2K when those documents were created afresh with a macro. (If you merely try to delete the style and substitute a macro in the same document, you probably won't see much of a saving.)

When you use a style to format a document, it appears that *WordPerfect* packs in your entire style-library file—not just the individual style you used—when you save the file to disk. Obviously, using a macro instead will save a lot. Unfortunately, however, paired styles can have unique advantages that cannot be duplicated by macros.

Even avoiding open styles can still leave you with long files, however. There are at least three additional file-shrinking techniques I'd like to suggest, though their efficacy can't be guaranteed: sometimes they work, sometimes they don't, and it's hard to predict when or why. (Once in a while they may actually increase, not decrease, the length of a file.)

Two variables that affect the success of a given file-shrinking method are the nature of the document and the subversion of 5.0 you're using. (I find that the following methods work better with the April 1989 release than with the October 1988 release.) In any case, you have nothing to lose except a few moments trying them. It's advisable to experiment with them in advance to see which one tends to work best with your release date of the program and with the kinds of

documents you create. All three depend on the fact that saved files often carry along invisible packets of unnecessary information that take up space at the head of the document but sometimes can be safely deleted.

- After saving a file, immediately retrieve it into a blank screen and resave it. (Set WP to make backups—Shift-F1, 1, 2, yes—to see the difference more easily.) I once created a title page containing just a formatting style and only 33 words of copy. The resulting file occupied 22,769 bytes of disk space. A resave shrank the file for me to less than 12,000 bytes—a 48 percent saving. Yet other files sometimes have yielded little or no saving with this method.

- *WordPerfect*'s technical representatives suggest a variant on the above. After saving the file, start with a fresh, blank screen and use the Spacebar to move the cursor one column to the right. Then go into List Files to retrieve the file. (Answer yes to the prompt "Retrieve into current document?") Once the document appears on the editing screen, Backspace once to delete the "empty" space at the head of the document where invisible packets may have been lurking. Then save the file again.

- Finally, investigate a shareware product called WPTOOLS, which is widely available on bulletin boards and contains a program called FIXPRE. I have found that it can not only strip off useless baggage from your all-important .SET file (and, according to its programmer, thereby sometimes cure mysterious formatting misfires), but it sometimes can reduce the length of ordinary data files, as well.



This problem with excessive-length files is one that will continue to plague *WordPerfect* users until we all get read-write optical disks. I can't add to Mr. Kay's suggestions on this point and must caution that sometimes the information contained in the massive "before you get to your text" headers may contain printer-important information, so experiment before you commit.

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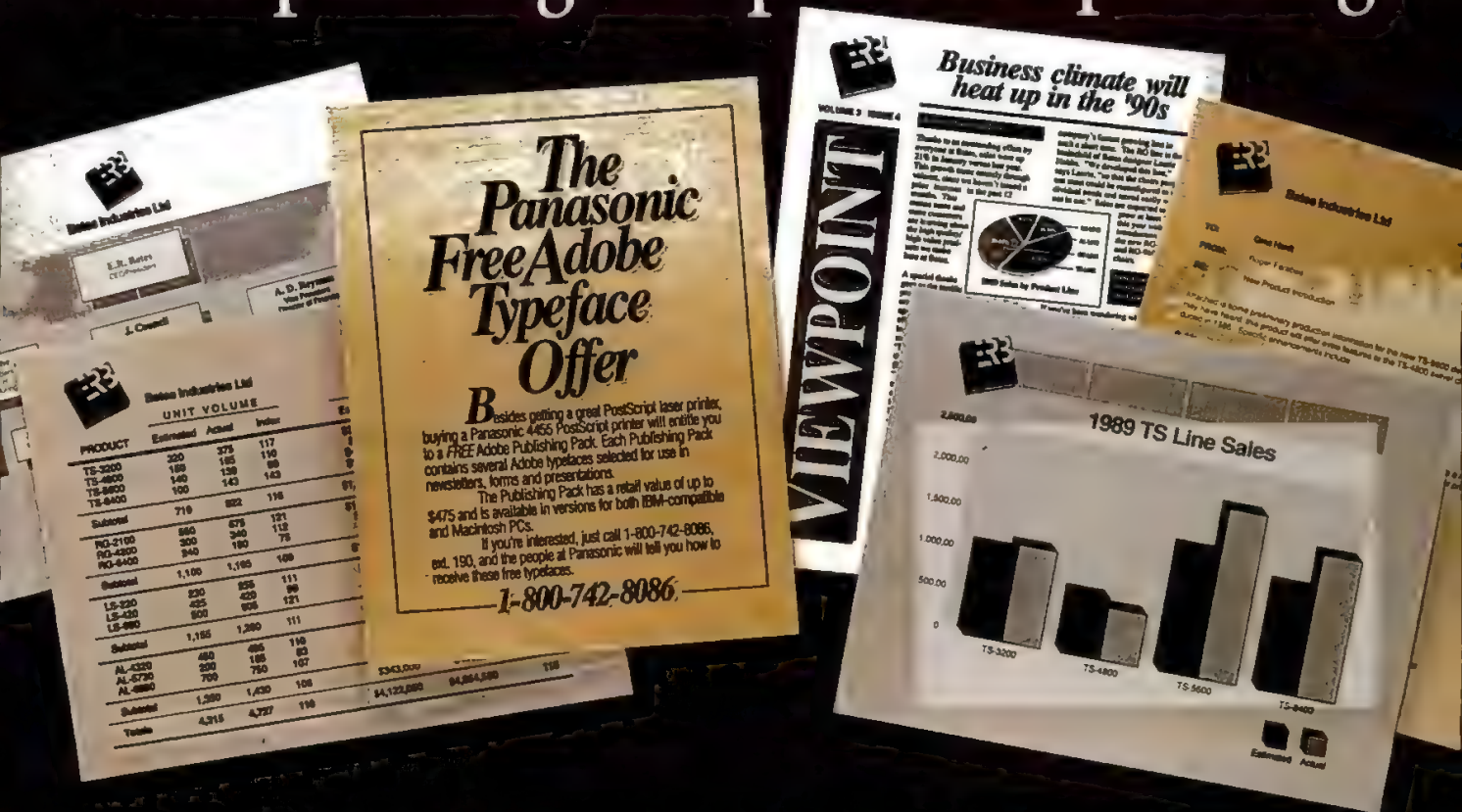
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CIRCLE 138 ON READER SERVICE CARD

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Neil J. Rubenking

User-to-User

SAVING YOUR CURRENT DIRECTORY

The DOS PATH command is an indispensable part of the operating system, allowing you to execute commands or run applications in the specified directories regardless of which directory is current. But the PATH command has at least one shortcoming. Some applications, such as *Lotus 1-2-3*, insist on being run from the directory containing the executable file. For these applications, a simple batch file such as the following will usually suffice:

```
@ECHO OFF
C:
CD \LOTUS
LOTUS
```

The problem with this method is that when you finish with the application, your default drive and directory have changed. If you're constantly popping in and out of the application, resetting the drive and path can become very annoying.

I therefore set out to write a batch file that would execute my application and then return to the drive and directory I started from. My initial plan was to have the batch file write a second batch file containing the appropriate CD command. After running the application, the first batch file would

■ **SAVING YOUR CURRENT DIRECTORY:** An unusual use of the PROMPT command shows you the way to go home.

■ **FINDING FILES:** Try these batch files instead of DIR when you're unsure of the filename.

chain to the second. However, if I changed the drive as well as the directory, CD wouldn't be enough. I solved the problem with the PROMPT command, which can display both the logged drive and the current directory.

The batch files SETRETRN and DORETURN (Figure 1) illustrate the technique. SETRETRN creates a second batch file (ZZZZZZZ1.BAT) and executing the second file creates a third (ZZZZZZZ2.BAT). It's the third file that returns you to the starting drive and directory when called by DORETURN.

To use the batch files, put them in a directory that's on your PATH, and make sure COMMAND.COM is also on the PATH. My batch files are in C:\BATCH.

You should change the string C:\BATCH to reflect where you store your batch files on your disk.

J. Kevin Wells
Yarmouth, Nova Scotia, Canada



The original batch files were specifically limited to running *Lotus 1-2-3*. I rewrote them slightly to create the generic batch files you see in Figure 1. The example Lotus batch file would now look like this:

```
@ECHO OFF
CALL SETRETRN
C:
CD \LOTUS
LOTUS
CALL DORETURN
```

If you're using a DOS version earlier than 3.3, just substitute COMMAND /C for CALL and delete the @ from the first line. Also, if you don't use \$p\$g as your standard prompt, change SETRETRN.BAT to restore the prompt to your own preference.

FINDING FILES

DIR is one of the most commonly used DOS commands, but it's also one of the most exasperating. To zero in on a file or group of files when you aren't sure of the

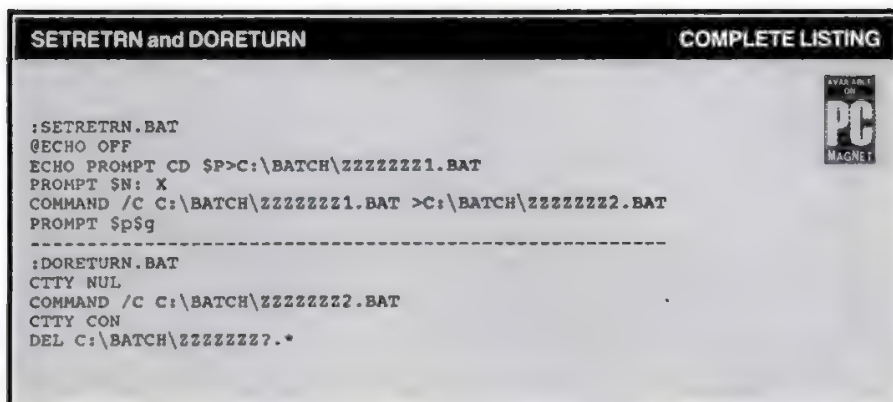


Figure 1: SETRETRN.BAT uses the PROMPT command to write a batch file that will return you to the current drive and directory. DORETURN.BAT calls that file when you're ready to return, and then deletes the temporary batch files.

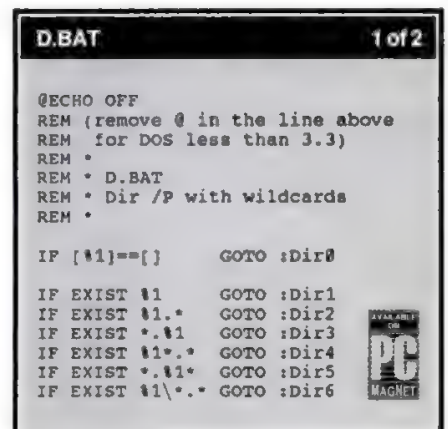


Figure 2: D.BAT lists files whose names are close to the string you pass it.

User-to-User

```

D.BAT 2 of 2

ECHO Sorry, no "%1" files found...
GOTO :End

:Dir2
Dir /P
GOTO :End

:Dir1
Dir /P %1
IF EXIST %1.* GOTO :Dir2
GOTO :End

:Dir2
Dir /P %1.*
IF EXIST %1.* GOTO :Dir3
GOTO :End

:Dir3
Dir /P %1
GOTO :End

:Dir4
Dir /P %1.*
IF EXIST %1.* GOTO :Dir5
GOTO :End

:Dir5
Dir /P %1.*
GOTO :End

:Dir6
Dir /P %1\.*
GOTO :End

```

name, you have to hunt through a long directory listing or try various combinations of the DOS wildcard characters ? and * to find the files you need.

I finally wrote the batch file, D.BAT (Figure 2) to make it easier to find files. The idea is fairly simple. When looking for a file, you usually know *something* about how the filename or extension is spelled, but often just a little. Did I call my spreadsheet file WIDGET.WK1 or WIDGETS.WK1? Is my database FOOBAR.DBF or FOO-BAR.DBF

```

D2.BAT COMPLETE LISTING

@ECHO OFF
SET allfiles=.*
IF [%1]==[] GOTO showfiles
SET allfiles=%1.* %1.* %1\.*
IF EXIST %1.* GOTO showfiles
IF EXIST %1\.* GOTO showfiles
IF EXIST %1\.* GOTO showfiles
ECHO Sorry, no "%1" files found...
GOTO End
:showfiles
FOR %%v IN (%allfiles%) DO ECHO %%v
:End
SET allfiles=

```

Figure 3: This is a streamlined version of D.BAT—it also lists files whose names are close to the string you pass to it.

```

DIRANY.BAT COMPLETE LISTING

@ECHO OFF
IF '%1'=='' GOTO syntax
FOR %%v IN (1 2 3 4 5 6 7 8) DO IF %2==%%v GOTO OK
GOTO syntax
:OK
SET temp=%1.*
rem If name has 8 letters, we're done
IF %2==8 GOTO doit
SET temp=%temp% ?%1.*
IF %2==7 GOTO doit
SET temp=%temp% ??%1.*
IF %2==6 GOTO doit
SET temp=%temp% ???%1.*
IF %2==5 GOTO doit
SET temp=%temp% ????%1.*
IF %2==4 GOTO doit
SET temp=%temp% ?????%1.* %.%1
IF %2==3 GOTO doit
SET temp=%temp% ??????%1.* %.%1
IF %2==2 GOTO doit
SET temp=%temp% ???????%1.* %.%1
:doit
FOR %%f IN (%temp%) DO ECHO %%f
SET temp=
GOTO end
:syntax
ECHO DIRANY lists files whose names contain a certain string.
ECHO Syntax: "DIRANY string n"
ECHO where "string" is a string of 1 to 8 characters
ECHO (no wildcards) and "n" is the length of that string.
:end

```

Figure 4: Pass a string to DIRANY.BAT and it will list all the files whose names contain that string.

or FOO_BAR.DBF? What files have an extension of XYZ? Do any start with the letter Q? D.BAT can answer all of these questions quickly and easily.

You simply type the letter D followed by a space and whatever portion of the filename you know. For example:

You Enter	D.BAT Enters
D WIDGET	DIR /P WIDGET*
D FOO	DIR /P FOO*.*
D XYZ	DIR /P *.XYZ
D Q	DIR /P Q*.*

D.BAT uses the IF EXIST command to build up to seven different DIR commands. By combining your command-line input with the results of the IF EXIST filename search, D.BAT shows you the filenames most like what you are looking for.

Bruce P. Holmen
Santa Paula, California

PC MAGAZINE D.BAT is a grand idea, but it won't necessarily show you *all* the files that contain your partial filename, and it may show some of them twice. D2.BAT (Figure 3) is a streamlined version. Instead of calling DIR several times, it uses the FOR command to echo the name of any file that's *close* to what you typed on the command line. In this case, close means the file matches one of

three file templates. Suppose you typed

D2 WP

it would list files matching WP*.*, *.WP*, or WP\.*.*.

DIRANY.BAT (Figure 4) takes the concept one step further—it will find any file whose name or extension *contains* the string you pass on the command line. Because the batch file processor isn't terribly smart, you also have to pass the *length* of the string. DIRANY builds a list of file templates that cover any possible position of that string within a filename. For example, if you type

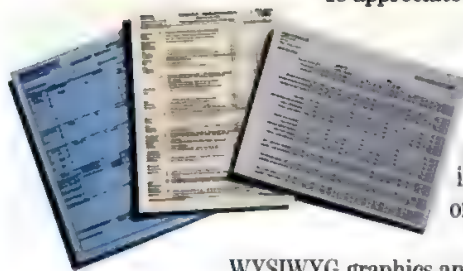
DIRANY PCMAG 5

it will look for files matching PCMAG*.*, ?PCMAG*.*, ??PCMAG*.*, and ???PCMAG.*. If D.BAT and D2.BAT don't find your file, try DIRANY!

SHARE YOUR SECRETS

Reveal your latest DOS and systems discoveries through User-to-User, and we'll pay you \$50 for any submissions we print. Please submit your letter on a disk together with a printout. Mail your contributions to User-to-User, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). ■

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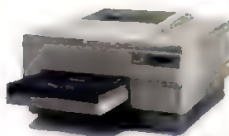
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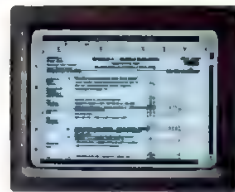


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CIRCLE 257 ON READER SERVICE CARD



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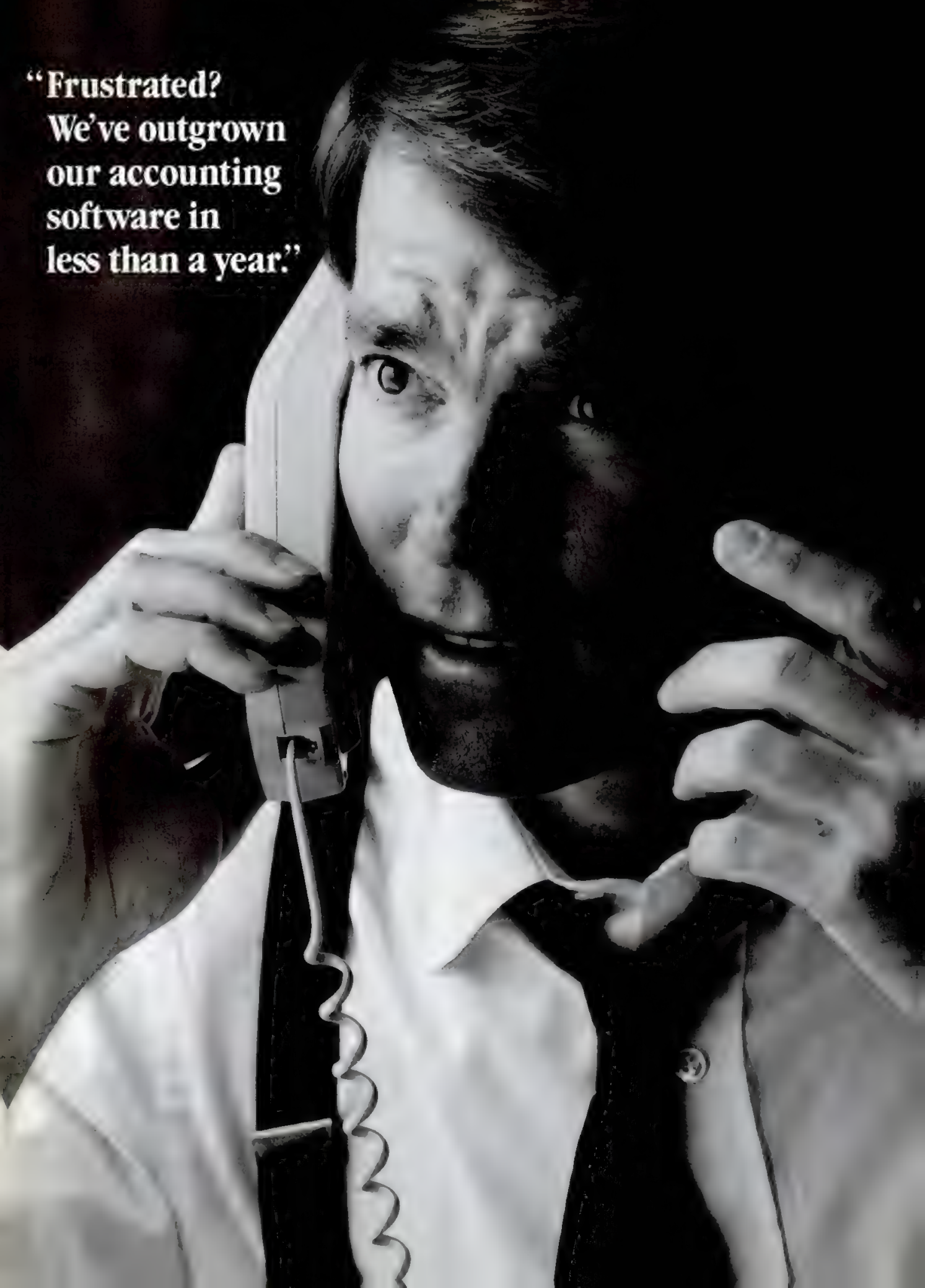
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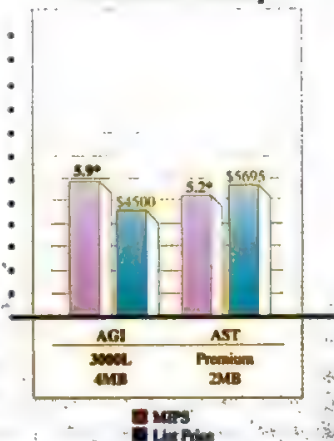
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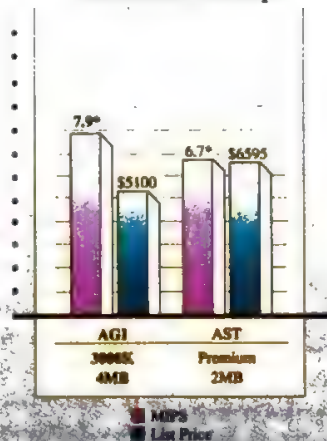
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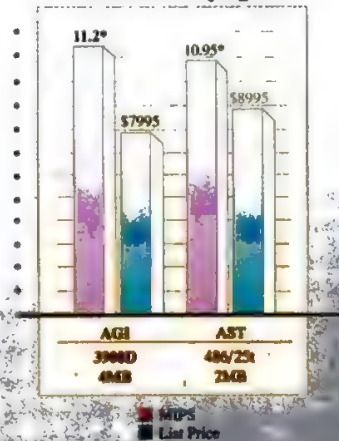
386-25MHz Desktop



386-33MHz Desktop



486-25MHz Upright



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CIRCLE 107 ON READER SERVICE CARD

by
Jeff Proise

Tutor

REINITIALIZING DISKS

While poking around on a bunch of old floppy disks with DEBUG, I discovered that each different formatting program I've used in the past—DOS's FORMAT.COM, *The Norton Utilities'* Safe Format, and *PC Tools Deluxe's* PC Format, to name a few—places an ASCII identifier in the first sector of the disk. A disk formatted with MS-DOS 3.3 contains the string "MSDOS3.3;" a disk formatted with Safe Disk "IBM PNCI;" and a disk formatted with PC Format "PCFormat".

What's the significance of these character strings? What else is there of interest in the first sector of a disk? And finally, is there a difference in the way FORMAT.COM, Safe Disk, and PC Format initialize disks?

Larry L. Feickert

Sioux Falls, South Dakota



The first logical sector of a DOS disk is known as the boot sector. It is used by DOS to store information about the media type and the structure of the file system the disk was formatted for. It also contains the bootstrap code that DOS uses to load itself from disk during start-up.

Figure 1 shows the format of the boot sector. The first 3 bytes contain a machine language JMP instruction that transfers control to DOS's bootstrapping code. The values found there will always be E9h (the opcode for an intrasegment jump) followed by a 16-bit displacement, or EBh (a short jump) followed by an 8-bit displacement and an NOP instruction (90h). When the disk is used for start-up, the PC's ROM-based bootstrap loader reads the first sector into the computer's memory and executes the JMP instruction to initiate the bootstrapping process.

The 8 bytes starting at offset 03h in the boot sector are reserved for the name of the program or operating system that formatted the disk. Traditionally, the formatting utility writes an ASCII character string to this slot that identifies the brand and version number of the operating system.

■ **REINITIALIZING DISKS:**
Not all formatting programs work the same—intelligent ones leave the root directory and data areas intact.

The area spanning the range from offsets 0Bh through 17h is known as the BIOS Parameter Block, or BPB. The BPB holds everything DOS needs to know about the formatted structure of the disk: the number of bytes per sector, number of sectors per cluster, number of reserved sectors, number of copies of the file allocation table (FAT), number of root directory entries, number of sectors, the media descriptor byte, and the size of the FAT in sectors.

Offsets 18h through 1Dh hold information about the physical makeup of the disk: the number of sectors per track, the number of heads or sides, and the number of hidden sectors. DOS 4.0 assigns meaning to the ensuing 32 bytes as well—2 bytes to form the high word of a 4-byte hidden sector count, 4 for the number of total sectors, 1 to record the physical drive number, 1 reserved, 1 for the extended boot record signature, 4 for the serial number, 11 for the volume label (stored as a root directory entry in previous versions of DOS), and 8 reserved for unspecified uses at the end.

In DOS 4.0, two of the fields—the sector count at offset 13h and the sector count at offset 20h—are redundant. The first field is 1 word long and used on formatted volumes less than 32MB in size, and the second is 2 words long and filled in only on large (greater than 32MB) volumes. Earlier versions of DOS, which did not support large volume sizes, used the entry at offset 13h exclusively.

The bootstrap code may start anywhere from offset 1Eh onward, depending on what version of DOS you're using. The job of the short program contained there is

a daunting one. It loads the operating system from disk and gets the machine started using a length of code consisting of no more than 512 bytes (the length of one sector) minus the length of the BPB and other system areas. Suffice it to say that this limitation on code length is the primary reason DOS imposes the restriction on system disks that the directory entries for the system files IBMBIO.COM and IBMDOS.COM (or IO.SYS and MSDOS.SYS) be located in the first two slots of the root directory and that IBMBIO.COM be stored in contiguous sectors starting with the first cluster.

If you're interested in exploring the bootstrap loader further and are comfortable with DEBUG, insert a system-formatted floppy disk into drive A:, start DEBUG, and type L 0 0 0 1 to load the boot sector into memory at offset 00h. Then type U 0 and resume tracing through the code at the address targeted by the unassembled JMP instruction.

Do FORMAT.COM, Safe Format, and PC Format format disks the same way? Applied to a new, never-before-formatted floppy disk, yes: each one initializes the boot sector, two copies of the FAT, the root directory, and the portion of the disk where file data is stored using nearly identical methods.

But how these utilities format disks that have been previously formatted varies substantially. FORMAT.COM treats a preformatted disk the same as it does a new one, completely reinitializing it from start to finish, and in the process, rendering any existing data on the disk unrecoverable. Safe Format and PC Format, by contrast, preserve data on a preformatted disk by simply erasing existing files rather than overwriting them. The result: since erased files can be restored using any one of a number of unerase utilities, files on disks formatted with Safe Format or PC Format can be successfully recovered after an accidental format.

The sector maps in Figure 2 illustrate why. Figure 2(a) shows a DEBUG-type

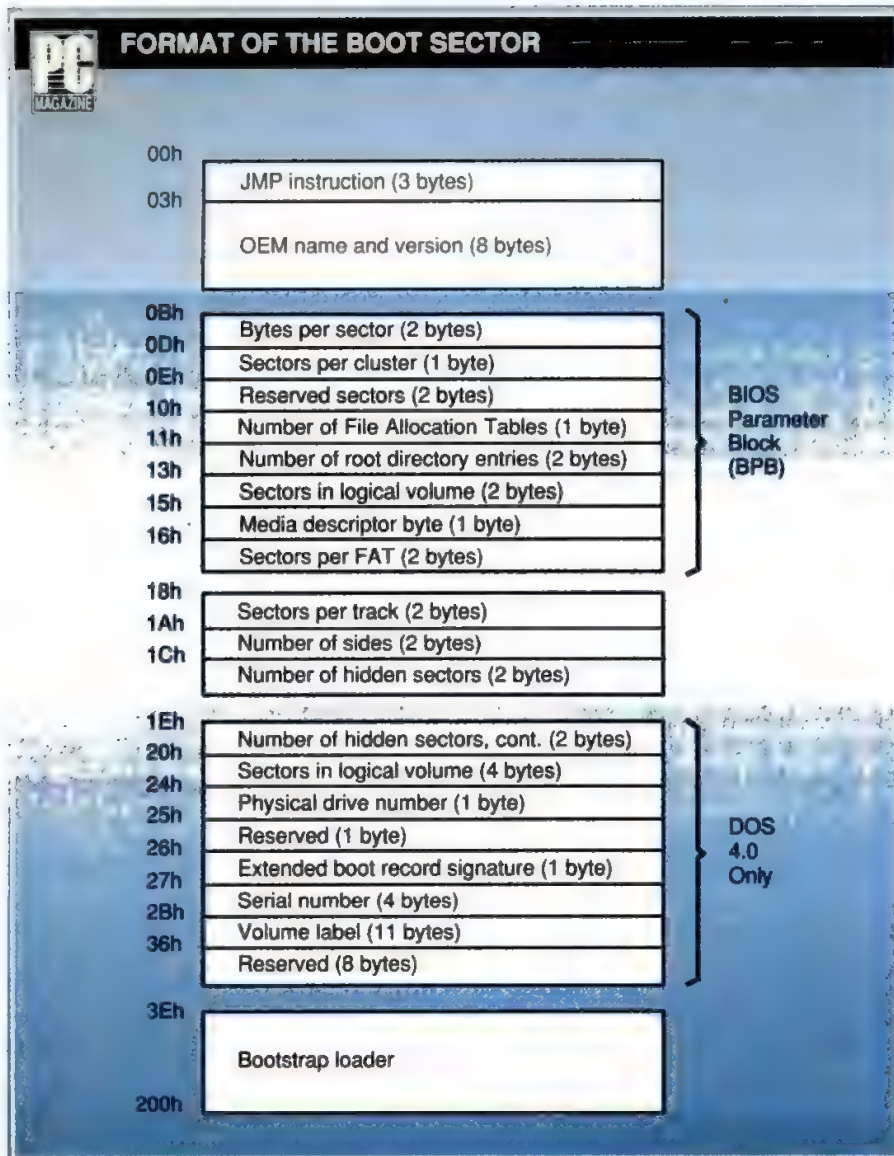


Figure 1: The first logical sector of a DOS disk, known as the boot sector, is used by DOS to store information about the media type and the structure of the file system the disk was formatted for. It also contains the bootstrap code that DOS uses to load itself from disk at start-up.

RESULTS OF DIFFERENT FORMATTING PROGRAMS										1 of 2
(A): Original contents of disk										
1ADD:0000	EB 34 98 49 42 4D 29 28 33 8B 02 02 01 00	.4 IBM 3.3.....								
1ADD:0010	02 78 00 D8 02 7D 02 00 00 00 00 00 00 00	.p.....								-- Boot Sector
1ADD:0020	00 00 00 00 00 00 00 00 00 00 00 00 00 00	3.....								
1ADD:0030	00 2E 00 00 01 00 7A 33 C0 0E D8 DC 00 7C 16 07									
1ADD:0200	FD FF FF FF 4F 00 FF 07 00 00 00 00 00 00	O.....								
1ADD:0210	00 00 00 00 00 00 00 00 00 00 00 00 00 00									-- FAT
1ADD:0220	00 00 00 00 00 00 00 00 00 00 00 00 00 00									
1ADD:0230	00 00 00 00 00 00 00 00 00 00 00 00 00 00									

Figure 2: When applied to a preformatted disk, both *The Norton Utilities'* Safe Disk and *PC Tools'* PC Format preserve data by simply erasing any existing files rather than reinitializing the root directory and the area where file data is stored. By contrast, DOS's *FORMAT.COM* completely reinitializes the disk, rendering any files that were previously stored there unrecoverable by conventional means.

hex dump of selected portions of the boot sector, FAT, root directory, and data area of a freshly formatted 360K disk containing two files—COVER.DOC and CONTACTS.DOC. The disk was formatted with PC-DOS 3.3's *FORMAT.COM*. The OEM identification field in the boot sector bears DOS's identifying mark, while the FAT and root directory contain entries for the two files and the data area holds the actual bytes that make them up.

Figure 2(b) shows the same areas after the disk is reformatted with *FORMAT.COM*. The FAT, root directory, and data area have been reinitialized. The root directory, which previously held filename entries for COVER.DOC and CONTACTS.DOC, now holds all zeros. And all bytes in the data area have been re-

The files on the disk reformatted with Safe Format or PC Format still reside physically on the surface of the disk and can be recovered should the need arise.

placed with the value F6h.

Figures 2(c) and 2(d) show what the disk would look like had it been reformatted with Safe Format and PC Format, respectively, using each utility's default formatting parameters. Both programs reinitialize the boot sector (as evidenced by the strings "IBM PNCI" and "PCFormat" in the boot sector) and the FAT, but leave the root directory and data area largely intact. Rather than destroy files the way *FORMAT.COM* does, Safe Format and PC Format erase them by replacing the first character in each filename with E5h and zeroing the corresponding entries in the FAT. For all outward appearances, the root directory is just as empty as on the disk reformatted with *FORMAT.COM*. But the original files on the disk reformatted with Safe Format or PC Format still reside physically on the surface of the disk

RESULTS OF DIFFERENT FORMATTING PROGRAMS

2 of 2

```

IADD:0A00 43 47 56 45 52 28 20 28-44 4F 43 20 00 00 00 00 COVER DOC ....
IADD:0A10 00 00 00 00 00 00 34 AB-8D 13 02 00 00 03 00 00 .....4.....
IADD:0A20 43 47 4E 54 41 43 54 53-44 4F 43 20 00 00 00 00 CONTACTSDOC ....
IADD:0A30 00 00 00 00 00 00 3A 97-66 13 03 00 2E 04 00 00 .....f.....

```

```

IADD:1800 09 09 09 09 09 09 09 09-31 37 20 4E 6F 72 74 60 .....17 North
IADD:1810 77 65 73 74 65 72 6E 28-58 6C 61 7A 61 0A 09 09 western Plaza...
IADD:1820 09 09 09 09 09 09 53 75-69 74 65 20 33 34 37 0A .....Suite 347.
IADD:1830 09 09 09 09 09 09 09 09-4F 61 6B 20 52 69 64 67 .....Oak Ridg

```

(B): After formatting with FORMAT.COM

```

IADD:0000 EB 34 90 49 42 4D 20 20-33 2E 37 00 02 02 01 00 .4.IBM 3.3....
IADD:0010 02 70 00 D0 02 FD 02 00-09 00 02 00 00 00 00 .p.....
IADD:0020 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....3.....
IADD:0030 00 00 00 00 01 00 FA 33-C0 8E D0 BC 00 7C 16 07

```

```

IADD:0200 FD FF FF 00 00 00 00 00-00 00 00 00 00 00 00 .....
IADD:0210 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0220 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0230 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....

```

```

IADD:0A00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0A10 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0A20 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0A30 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....

```

```

IADD:1800 F6 F6 F6 F6 F6 F6 F6-F6 F6 F6 F6 F6 F6 F6 .....
IADD:1810 F6 F6 F6 F6 F6 F6 F6 F6-F6 F6 F6 F6 F6 F6 .....
IADD:1820 F6 F6 F6 F6 F6 F6 F6 F6-F6 F6 F6 F6 F6 F6 .....
IADD:1830 F6 F6 F6 F6 F6 F6 F6 F6-F6 F6 F6 F6 F6 F6 .....

```

(C): After formatting with SAFE DISK

```

IADD:0000 EB 20 90 49 42 4D 20 50-4E 43 49 00 02 02 01 00 .(.IBM PNCI....
IADD:0010 02 70 00 D0 02 FD 02 00-09 00 02 00 00 00 00 .p.....
IADD:0020 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....3.....
IADD:0030 F0 7B FB B8 C0 07 0E D8-BE 5B 00 9C AC 0A C0 .(.

```

```

IADD:0200 FD FF FF 00 00 00 00 00-00 00 00 00 00 00 00 .....
IADD:0210 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0220 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0230 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....

```

```

IADD:0A00 E5 4F 56 45 52 20 20 28-44 4F 43 20 00 00 00 00 .OVER DOC ....
IADD:0A10 00 00 00 00 00 00 34 AB-8D 13 02 00 00 03 00 00 .....4.....
IADD:0A20 E5 4F 4E 54 41 43 54 53-44 4F 43 20 00 00 00 00 .CONTACTSDOC ....
IADD:0A30 00 00 00 00 00 00 3A 97-66 13 03 00 2E 04 00 00 .....f.....

```

```

IADD:1800 09 09 09 09 09 09 09 09-31 37 20 4E 6F 72 74 60 .....17 North
IADD:1810 77 65 73 74 65 72 6E 28-58 6C 61 7A 61 0A 09 09 western Plaza...
IADD:1820 09 09 09 09 09 09 53 75-69 74 65 20 33 34 37 0A .....Suite 347.
IADD:1830 09 09 09 09 09 09 09 09-4F 61 6B 20 52 69 64 67 .....Oak Ridg

```

(D): After formatting with PC FORMAT

```

IADD:0000 EB 3E 90 50 43 46 6F 72-6D 61 74 00 02 02 01 00 .>.PCFormat....
IADD:0010 02 70 00 D0 02 FD 02 00-09 00 02 00 00 00 00 .p.....
IADD:0020 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0030 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....

```

```

IADD:0200 FD FF FF 00 00 00 00 00-00 00 00 00 00 00 00 .....
IADD:0210 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0220 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
IADD:0230 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....

```

```

IADD:0A00 00 4F 56 45 52 20 20 28-44 4F 43 20 00 00 00 00 .OVER DOC ....
IADD:0A10 43 74 53 61 76 00 34 AB-8D 13 02 00 00 03 00 00 C2Sav.4.....
IADD:0A20 00 4F 4E 54 41 43 54 53-44 4F 43 20 00 00 00 00 .CONTACTSDOC ....
IADD:0A30 43 74 53 61 76 00 3A 97-66 13 03 00 2E 04 00 00 C2Sav.1.f.....

```

```

IADD:1800 09 09 09 09 09 09 09 09-31 37 20 4E 6F 72 74 60 .....17 North
IADD:1810 77 65 73 74 65 72 6E 28-58 6C 61 7A 61 0A 09 09 western Plaza...
IADD:1820 09 09 09 09 09 09 53 75-69 74 65 20 33 34 37 0A .....Suite 347.
IADD:1830 09 09 09 09 09 09 09 09-4F 61 6B 20 52 69 64 67 .....Oak Ridg

```

where they can be recovered should the need arise. Those on the disk reformatted with FORMAT.COM cannot.

Another reason to use a smart formatting utility—one that leaves the root directory and data areas intact on a disk that isn't being formatted from scratch—is that it allows the formatting process to proceed much faster. Safe Format and PC Format format preformatted disks much faster than FORMAT.COM. Both programs also offer additional quick-formatting options, which not only speed the format up further, but leave even more of the original contents of the disk intact. Safe Disk's Quick Format option, for example, leaves

the contents of the boot sector unmodified, working only in the FAT and root directory. PC Format's /Q option does the same.

ASK THE TUTOR

The Tutor solves practical problems and explains points of general interest about using your hardware and software more productively. Questions about DOS and systems in general are also answered. Send your questions to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). We're sorry, but we cannot answer questions personally. ■

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by
Frank J. Derfler, Jr.

Connectivity

REMOTE CONTROL

Fresh Technology Group sells a number of products that make the LAN a happier place for administrators. The latest good idea from this Arizona-based company (telephone (602) 497-4200) is a \$179 product called *Remote Console*. The console that this product remote-controls is the screen and keyboard on your *Advanced NetWare 2.x* server. Yes, this means you can see the famous Novell *Monitor* display on the screen of your desktop PC! You can lock all of your servers away in a closet and still retain the critical print queue management capabilities that can only run from the server's console close at hand. Also, you can see the output of the Novell Transaction Tracking System on your own screen.

Remote Console is one of the few available value-added process (VAP) programs for *NetWare*. A VAP is a program that runs on an *Advanced NetWare 2.1x* server—like a *NetWare* Loadable Module for *NetWare 386*. The *Remote Console* VAP takes about 2K of server memory and very little attention from the CPU. However, a VAP must log on to the server when the server boots, and this requires a keyboard entry from someone watching the booting process. The print queues and other functions won't work until someone replies to the "Load VAP?" question, so this becomes an important action for any network manager who elects to use *Remote Console*. Still, we think the gain is worth the pain.

An important benefit of using this product is that it lets you control the console from across town or across the country. To do this, set up *Remote Console* to control your server's display and keyboard. Then use a modem and *Close-Up*, *pcAnywhere*, *Remote2*, *Carbon Copy*, or a similar program to remote-control your desktop PC. Now you can control the server's console from any location via your PC. *Remote Console* is a great little program from a company with a seemingly endless supply of good ideas.

- **REMOTE CONTROL:**
Manage your network from across the room or across the country.
- **INSTALLING NETWARE:**
Here's another tip for speeding the installation of *NetWare ELS I*.
- **GOING THE DISTANCE WITH ETHERNET:**
Extending a thin Ethernet network.
- **LINKING MACs AND PCs:**
Use a data switch to access Mac devices from a network of PCs.

INSTALLING NETWARE

In the November 14, 1989, issue of *PC Magazine*, you printed a tip on installing Novell *NetWare ELS I* using the services of *Advanced NetWare* to make the job quicker and easier. The tip was a good one, but there is another way that's even faster to do an installation, without having to use other versions of *NetWare*.

My procedure is the same up to the point of using the *Advanced NetWare 286* HotFix utility program. First, I use Ontrack Computer Systems' *Disk Manager-N* to prepare the hard disk drive for *NetWare*. Then, I insert a working copy of the Novell Start diskette that was formatted with a system and includes *COMMAND.COM*. Typing *SYSLOAD 3 START* sets up the hard disk for HotFix and loads the system and public files.

This procedure is faster and simpler and it eliminates the necessity of changing versions of *NetWare*. Your column has greatly assisted me, and I hope this tip will help others.

Bruce M. Sutherland
West Palm Beach, Florida



Every *NetWare* LAN supervisor who might do more than one *Advanced NetWare 286* or *NetWare ELS* installation a year should have a copy of Ontrack's *Disk Manager-N*. The product sells for \$249.95, and there is a separate version for IBM PS/2 computers. Contact Ontrack Computer Systems at (612) 937-1107.

GOING THE DISTANCE WITH ETHERNET

We need to connect a few stations in our school's administration building to the Ethernet network in the computer center. The cable run between the buildings will be about 800 feet. We already have 600 feet of thin Ethernet cable in the computer center. Should I use a bridge or a router or what? Some of these devices cost thousands of dollars and, of course, we don't want to pay for more than we need.

Troy Stegman
Herndon, Virginia



A bridge or a router links two separate networks with their own servers. When LANs have separate server resources, it isn't necessary to ship every packet between the networks. Many packets will stay local, so you use a device like a bridge or router that knows which destinations are on which side. Since you just want to extend a single network out beyond the 1,000-foot cable limit of thin Ethernet, you can use a simpler device called a repeater. The repeater is connected between the cable segments, and it regenerates packets going in each direction. The repeater plays the listen-before-transmit game with each cable segment to prevent packet collisions.

One of the most economical repeaters on the market comes from IMC Networks Corp. Its PCnic LANrepeater sells for \$895. However, since cost is a factor, you should know about another solution offered by IMC. This solution will drive the standards purists who patrol this column a little crazy, but it works.

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Connectivity

For \$595, you can get IMC's PCnic LANextender. This product does not meet the IEEE 802.3 specifications for a repeater. It doesn't regenerate the packet and gently slip it into the traffic stream on the other side. It simply provides the proper electrical environment to prevent signals from getting lost in the longer cable and lets packets cross over as they arrive. The potential difficulty with this approach is that it allows the possibility of collisions.

The Ethernet media access protocol says that every station should be able to hear some part of a packet being broadcast by any other station at the same moment. When you figure this out, it means you

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must consider the minimum size of the Ethernet packet, the time duration an adapter is "on the air" broadcasting the minimum size packet, and how fast this broadcast travels through the connecting media. The math involves the propagation speed of the electron or photon wave through the media and other factors, but it works out to about 1,000 feet for thin Ethernet. This means that if you limit your cable to 1,000 feet, the CSMA access scheme will work; collisions will be minimized and adapters will know if packets collide.

The designers of the PCnic LANextender take a more pragmatic approach. They say that under practical conditions you can let CSMA work on longer cables with little chance of error. Since most packets are much longer than the Ethernet

minimum, you can lengthen the cable and still retain the timing criteria. The \$300 difference between their LANextender and their IEEE 802.3-compliant LANrepeater will pay to equip another station on the network. I'd give the system a try. You can upgrade to a true repeater if you see problems such as slow response times or if you get error messages either from DOS or from the network software. Call IMC Networks at (714) 259-1020 to discuss your installation.

LINKING MACs AND PCs

As part of a reorganization, we recently gained a desktop publishing system centered on a Macintosh. All of our PCs are networked with ARCnet adapters and Novell servers. The Mac will remain a dedicated desktop publishing system, but we'd like to access its printers from the network of PCs. What's the best way?

Bill Gleason
Long Beach, California



It depends on the number of PCs you have, but generally the easiest and most hassle-free way to link these systems is through a data switch. Yes, Novell has a software solution and I presume you can get an ARCnet card for a Mac, but simply putting the Mac on the Novell network won't give you access to the Mac's printers.

Newbridge, one of the top data-switch companies, has a product called PC MAC that includes software for both PC and Macintosh computers, and a box that links them on command. You can share devices, transfer files, browse through directories, carry on split-screen conversations, and share the Novell networked resources, too. A Newbridge PC MAC system that can link eight PC and MAC devices sells for \$995 and is about half the size and weight of this magazine. Phone Newbridge at (703) 834-3600.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay \$50 for any tips we print. Please submit your letter on a disk along with a print-out. Mail your contributions to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named PC MAGAZINE LAN LABS). We're sorry, but we're unable to answer any letters personally.

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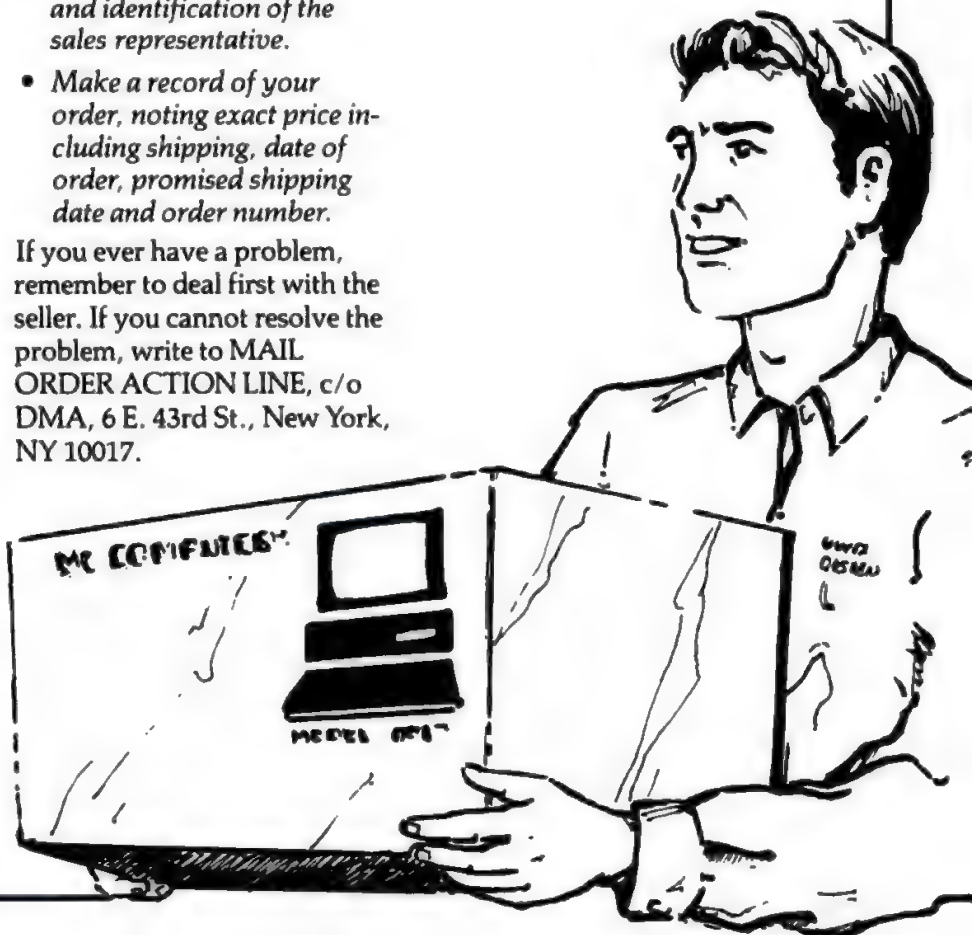
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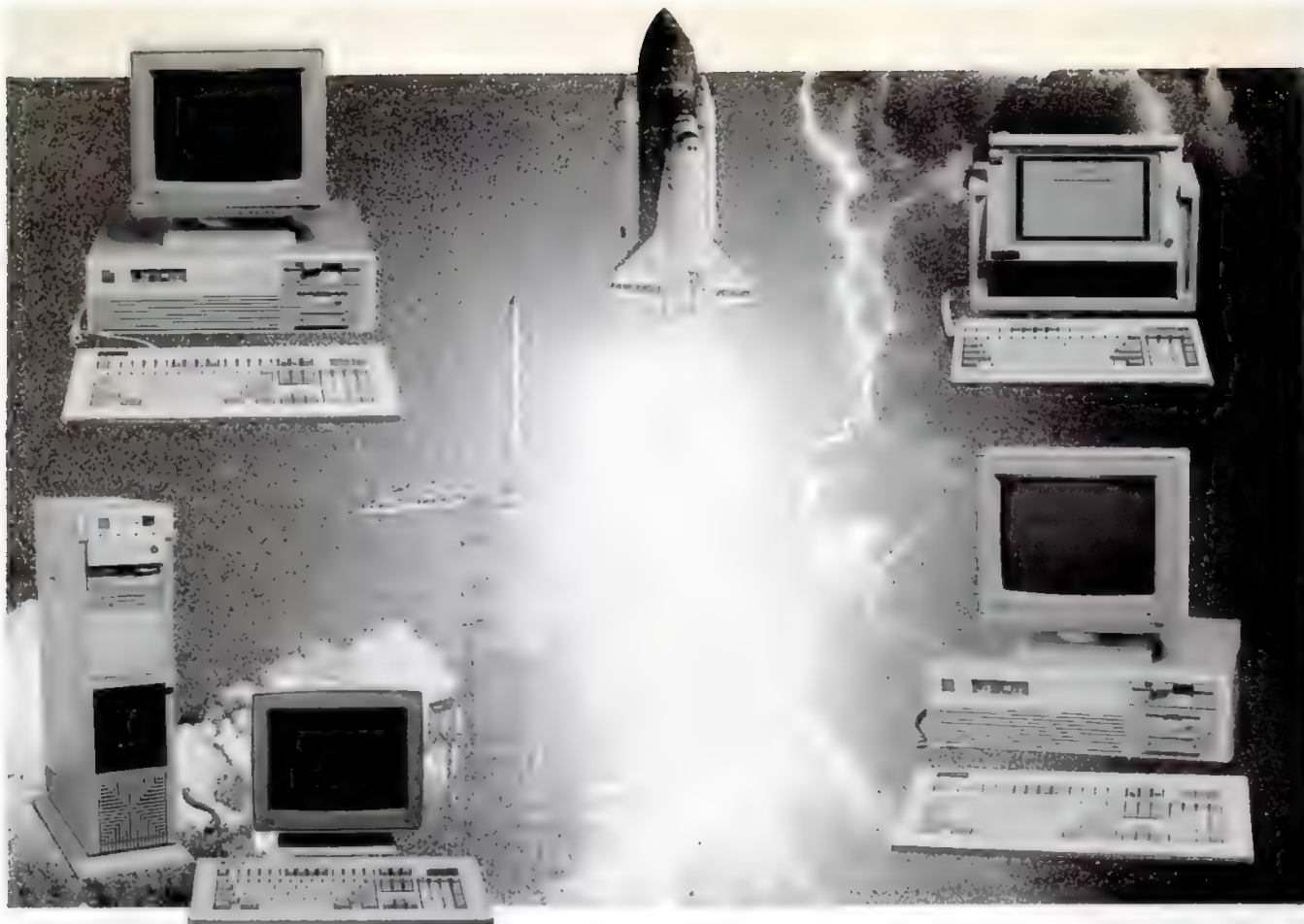
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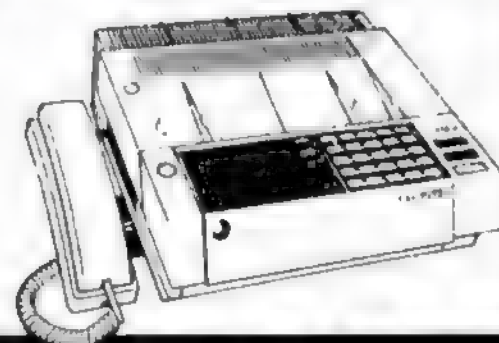
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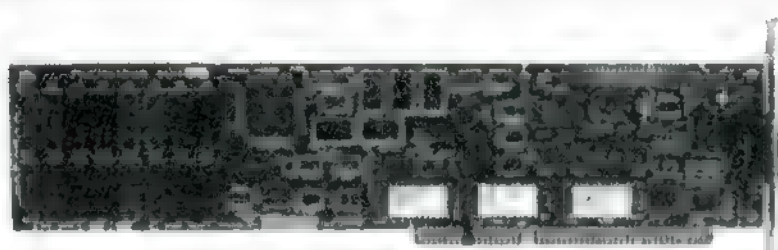
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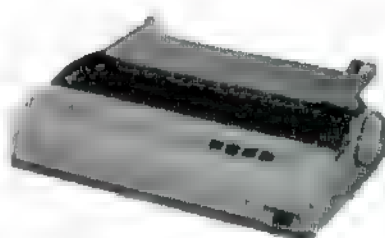
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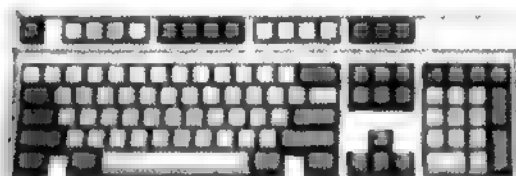


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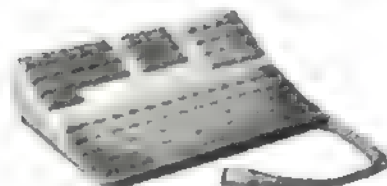
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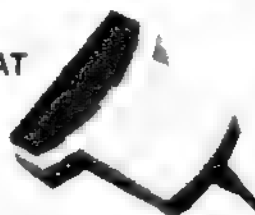


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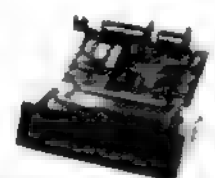


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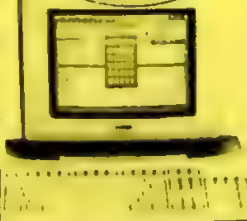
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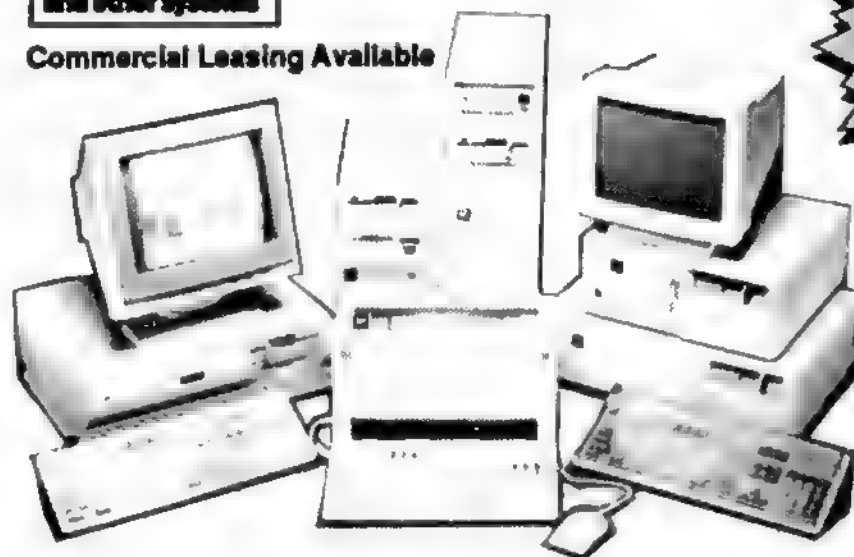
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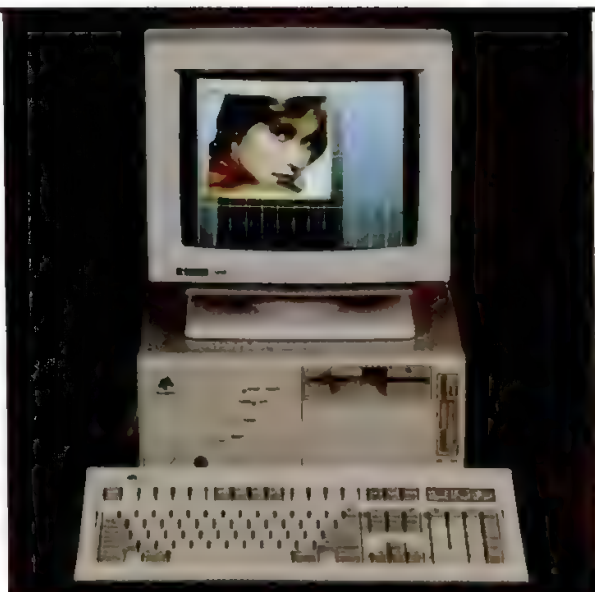
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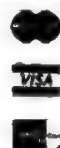
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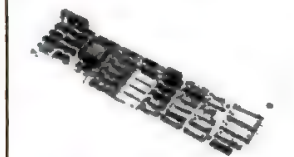
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COMMUNICATIONS

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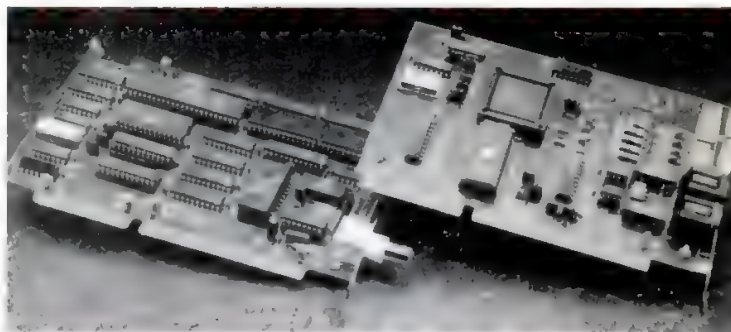
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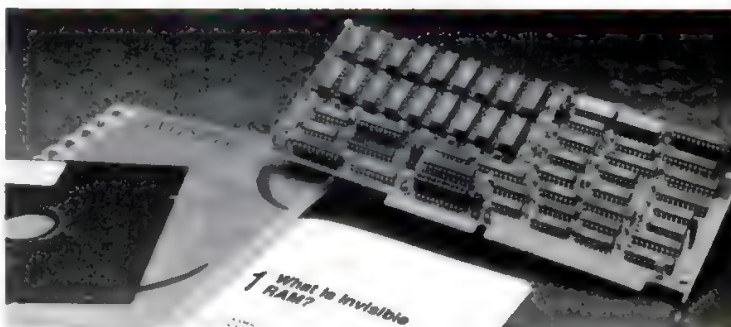
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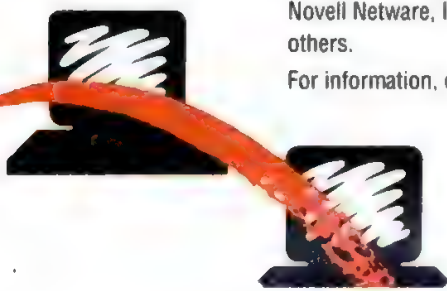


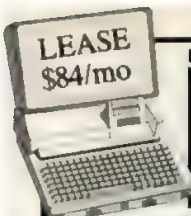
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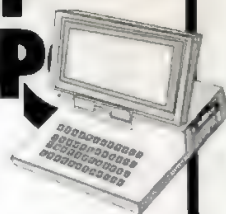
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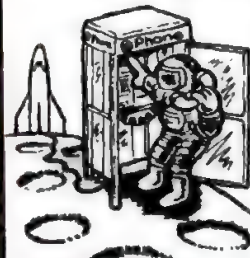
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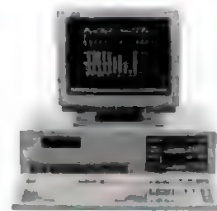
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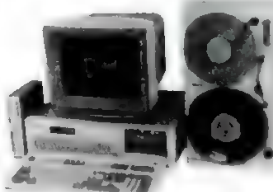
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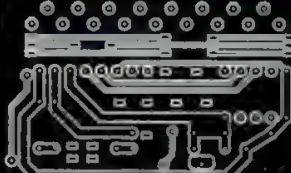
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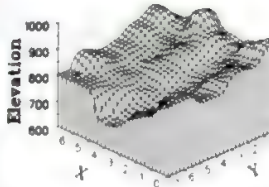
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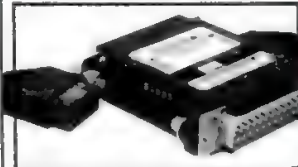
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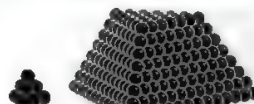
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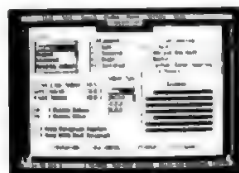
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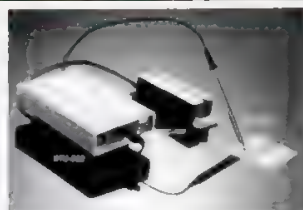
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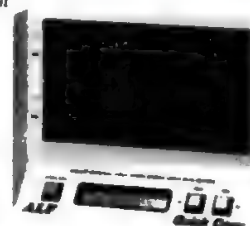
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■ VOICE E-MAIL

A revolutionary new alliance of voice and e-mail allows you to transmit voice, music, and other sounds across a LAN. PC LAN Labs evaluates three software and adapter board combinations—Wang's Freestyle System, Artisoft's LANtastic, and VoxLink's VoxMail—and explains their growing attraction.

■ MULTIMEDIA

PC Magazine takes its first look at the hot new area of multimedia—the integration of audio and video technology with computer graphics. Multimedia has exciting potential in business applications, but is it really ready for the business PC user? Find out in our review of five authoring systems that let you build interactive presentations incorporating computer animation and full-motion video from laserdiscs.

■ VGA/NTSC BOARDS

Getting your PC screen on tape requires special hardware to convert your graphics adapter's VGA signals to NTSC signals that are compatible with video devices. PC Labs tests four boards that let you record your PC-based slide shows and animations. They also overlay computer-generated titles and other artwork without requiring a separate video monitor.

■ WORD PROCESSORS FOR GRAPHICAL ENVIRONMENTS

Contributing editor Edward Mendelson outlines the advantages of graphical word processing in his evaluations of *Ami* and *Ami Professional*, *DeScribe*, *Legend*, and *Microsoft Word for Windows*.

■ 25-MHz 386 PCs

PC Labs tests 23 of the latest 25-MHz 386 computers. Not long ago, these machines were the top of the line, but with the introduction of the 20-MHz 386SX chip, they represent the new mid-range. Is the 25-MHz 386 still a wise investment? ■



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After Hours

Products for the Leisure Side of Personal Computing

Windows Interface Makes Connect On-line Service Easier and More Accessible



If you've used bulletin board services (BBSes) for some time, you may have forgotten your first bewildering on-line experience. Or, if you've never used a BBS, you may be scared off by stories of bare teletype interfaces,

the features of more well-known on-line systems like CompuServe or Genie: electronic mail, stock quotes, public message forums, databases of downloadable software, and on-line support from some software companies. In addition, groups of 20 or more can contact Connect directly to inquire about setting

book pops up from which you can choose names by pointing and clicking. You can even establish groups of recipients and give them a single nickname. At any point you can go on-line to reread mail, delete a message, or see who has read one and when. The mail has fairly effortless links to MCI Mail, Internet, and CompuServe.

But there are lots of annoying lapses in the mail interface. You cannot read a message and automatically add the sender to your address book. Remarkably, the delete key does not work in the editor. And you cannot reply to a message and have all the recipients of that message receive your reply.

Macnet is a good investment merely for stock tracking—you can easily check a dozen stocks once a day with a minute of connect time at a cost of 10 cents off-peak! Stock quotes are easy to set up; you can tell Macnet to get stock quotes every time you log on. Setup is simple if you know the S&P abbreviation for your stocks. Surprisingly, this information is not available on-line, except for a small number

ON-LINE SERVICES

USA Today Sports Center: Go Team!

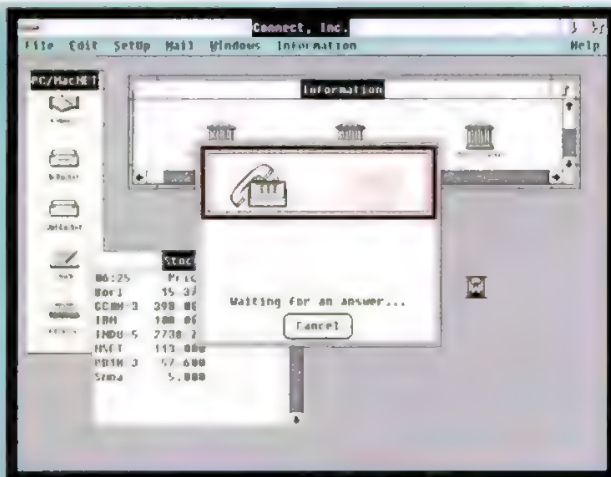
British Legends and Gemstone III: the spirit of Adventure on-line

of NYSE-traded firms.

The software will display each chosen stock with price and change. Double-clicking on an entry displays additional information. Not just stocks but futures, bonds, and averages are accessible as well.

Connect's forums need substantial improvement on the software side and a larger user base to be anywhere near as useful as the CompuServe forums accessed with a program like TAPCIS or ATO. Navigation among the forums is well implemented; they are arranged hierarchically. Once you find the ones you want, you can add their

CONTINUES



PC-Macnet brings the power of the Microsoft Windows graphical interface to Connect, a full-featured on-line information service.

arcane commands, and endless modem parameter hassles.

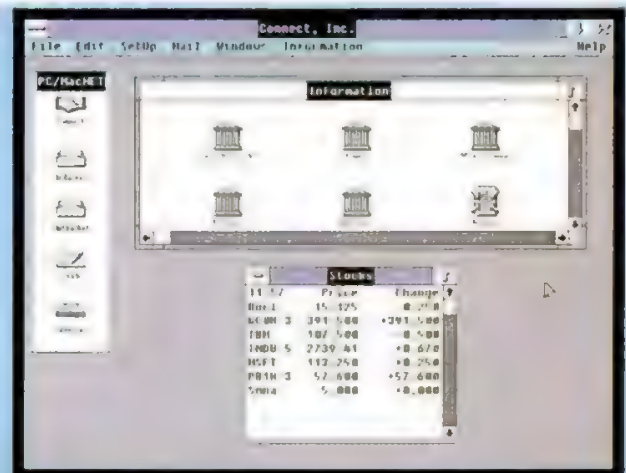
A recently debuted software package might just lay those fears to rest. PC-Macnet provides a graphical interface under Microsoft Windows for accessing the Connect on-line service. The combination makes for a rather different and much friendlier experience than any on-line service I've tried before.

Connect began as a service for Macintosh users, and the name of the PC-Macnet interface software reflects that history. Connect provides many of

up private forums.

Unlike Prodigy, Connect does not slow down to show you lots of cute pictures; instead, the graphical interface is devoted to simplifying navigation around the various parts of the service. Electronic mail and stock retrieval are especially well implemented.

To send mail, you begin by clicking on an icon or selecting a menu choice to create a message. You can specify multiple recipients in the To: and Cc: fields. Click on the word To: on the mail template and an address



The combination of PC-Macnet and the Connect on-line service lets you keep tabs on your stock portfolio. You can access futures, bonds, and averages as well as stocks.

After Hours

PC-Macnet

CONTINUED

icons to a special window and jump to them at any time. But after you reach the forums, *Macnet* really falls down. Messages are listed as individual entries, without the threads that most modern BBS systems have. You can collect the messages on-line, but you can't mark the ones you want off-line and then collect them automatically, as users of *TAPCIS* and *ATO* are used to doing on CompuServe.

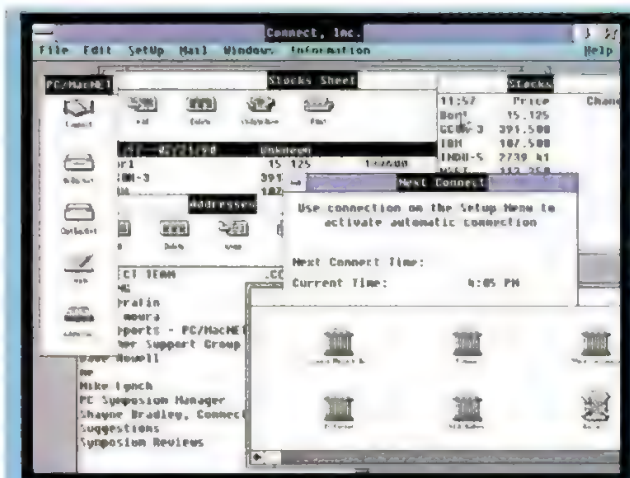
Even worse, you can't answer groups of messages off-line. Every time you post one message off-line, the software insists on dialing up and leaving that single message!

The only way to access Connect from a PC is with *PC-Macnet*; the \$99 purchase price for the software front-end includes one hour of connect time. After you use up the first hour, the costs are \$4/hour off-peak and \$8/hour peak at 1,200 or 2,400 bps (bits per second).

For sending simple electronic messages, the 7-cent-per-minute off-peak fee is attractive. There is a surcharge, however, of 2 cents during off-peak hours (3 cents peak) per 1,000 characters at transmission rates above 2,000 bytes per minute. So off-peak file downloading at 2,400 bps (and roughly 12K per minute) is 27 cents per minute, versus the 21 cents per minute that CompuServe costs.

The current version of *Macnet* is expected to be upgraded to real-mode *Microsoft Windows* 3.0 shortly, but protected-mode *Windows* 3.0 operation will require a complete rewrite and will not be available "for a while." Many of the defects in the forum interface will be addressed at that time.

Connect and *PC-Macnet* are an extremely promising idea, but for now, I'd recommend it only to those who desire the e-mail and stock-tracking features and who do not plan to switch to the protected mode of *Windows* 3.0. Once a protected-mode version of the software with a decent forum interface is available,



With its icons and other *Microsoft Windows* amenities, *PC-Macnet* smooths the way for neophyte modem users.

Connect and *PC-Macnet* should turn out to be a dynamite on-line combination.

List Price: *PC-Macnet*, \$99.95. Includes runtime *Microsoft Windows* and one hour free connect time. Additional costs for connect time: \$4 off-peak (7 P.M. to 7 A.M.), \$8 peak; 2 cents surcharge off-peak (3 cents peak) for each 1,000

bytes at transmission rates above 2,000 bytes/minute. All rates are for 1,200 or 2,400 bps; \$4/hr surcharge for 9,600 bps. **Requires:** 640K RAM, *Microsoft Windows*-supported graphics monitor, modem, DOS 3.0 or later. Connect Inc., 10101 Bubb Rd., Cupertino, CA 95014; (408) 973-0110.

CIRCLE 402 ON READER SERVICE CARD

All The Scores, and Much More, Via Your Modem

ON-LINE SERVICES
by Matthew J. Ross

Imagine this scenario. The New York Rangers are one game away from winning their first Stanley Cup in 50 years, and you are going to miss the excitement because your company is sending you on a sales trip to some remote city. You're totally cut off—the local news doesn't cover hockey.

Maybe you just need to know the score of your favorite baseball team's game, and you can't wait for tomorrow's sports page. Well, with the USA Today Sports Center on-line service, your PC, and a modem, you're just a phone call away from the latest sports news.

USA Today Sports Center is the first dedicated on-line sports information and interactive entertainment network. Drawing upon the talents of sports jour-

nalists from *USA Today* and the Gannett News Services, Sports Center offers 24-hour updates on the sports world. That includes the latest schedules,

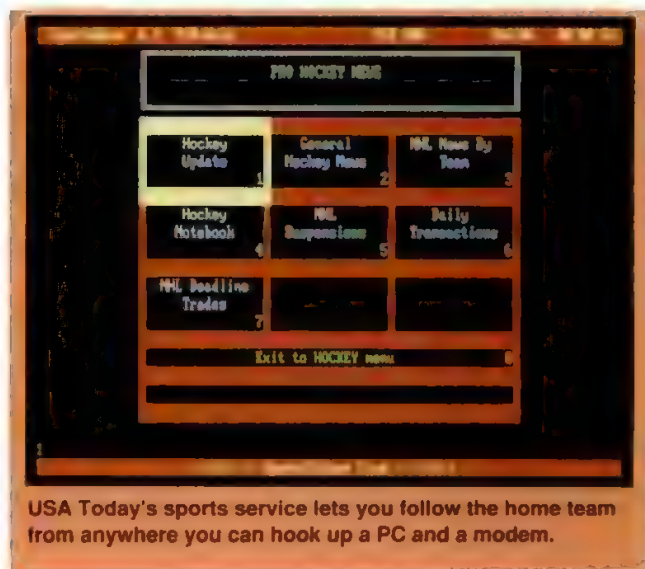
scores, and statistics. Sports Center's \$14.95 introductory price gains you admission to the service, complete with your own user account and password.

Not included in this price is *SportsWare*, a dedicated communications and menu package designed for Sports Center. You can connect to the Sports Center with any communications package (*ProComm Plus* worked just fine with it), but you must use *SportsWare* to gain access to the sports news "ticker tape" feature that runs across the bottom of your monitor. *SportsWare* costs \$24.95 at the time of sign-up, or \$29.95 if purchased through the Online Store.

The Online Store is just one of many features designed to satisfy the most demanding sports fan. You can order T-shirts, caps, and souvenirs of your favorite sports teams. You can also browse through the Sports Center's classified ads for that special piece of sports memorabilia, or place your own ad.

SportsWare allows easy customization of the service to save news items about your favorite sports teams, which helps keep connect-time charges down. This could be vital, because Sports Center gives you plenty of information to sort through. That might mean box scores from last night's NHL games, summaries of the college basketball tournament, and the latest baseball transactions, all of which are easily downloaded to your hard

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USA Today's sports service lets you follow the home team from anywhere you can hook up a PC and a modem.

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After Hours

Sports Center

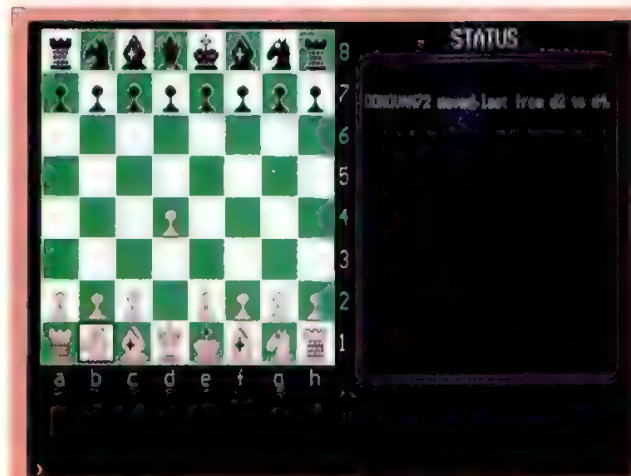
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disk or a floppy disk.

As with other on-line services, you can join forums and send e-mail. For those of you who don't live on sports alone, there is a news section, complete with international news, local events, weather, and travel information.

One of the best reasons for signing up has got to be Sports Center's fantasy sports leagues. You can join a league with other subscribers and run your own fantasy football, basketball, or rotisserie baseball team. Make trades, draft players, and watch as the service keeps track of the standings.

Other on-line games include chess, checkers, backgammon, reversi, blackjack, and poker. You can compete head-to-head with other subscribers and participate in regularly scheduled



The USA Today Sports Center lets naturally competitive sports fans go head-to-head in a variety of on-line games.

tournaments. I'm currently locked in a heated chess match with WGW of Florida, waiting for him to get back on-line and make his next move.

Access to the Sports Center is available through either the Tymnet or Telenet data networks, through an 800 service

offered by the Sports Center, or by dialing directly. Usage rates vary according to time of connection and method used. Tymnet and Telenet user rates are \$4.95 per hour after 6 P.M. and \$14.95 during business hours, plus the network's carrying charge. Direct-dialing costs

\$3.95 per hour plus the price of a long-distance call, while using the toll-free 800 number is \$17.95 during the day and \$12.95 during off-peak hours.

The USA Today Sports Center is not cheap. True fanatics could quickly rack up a tidy sum as they use this premium service. The Sports Center's features, however, are premium, too. Any fan will love the quick access to all the latest sports news, statistics, and schedules, not to mention the on-line fantasy football, basketball, and rotisserie baseball leagues. To put it simply, the USA Today Sports Center gives sports fans a reason for owning a modem.

List Price: USA Today Sports Center, \$14.95 subscription fee plus connect charges.

SportsWare, \$24.95. **Requires:** 256K RAM, DOS 2.0, modem.

USA Today Sports Center, Four Seasons Executive Center, Building 9, Terrace Way, Greensboro, NC 27403; (800) 826-9688, (919) 855-3491.

CIRCLE 403 ON READER SERVICE CARD

Genie and CompuServe Offer Die-Hard Adventure Fans Wide New On-line Worlds

ON-LINE SERVICES
by Tom Mostello

A lot of old-timers got their first exposure to computer games from a program called *Adventure*, which ran on the DEC PDP-11. Since nobody but big companies and universities actually owned a PDP-11, *Adventure* was mostly played by solitary users on stolen time. The game began with the words "You are standing at the end of a road in front of a house." From there, you were on your own, since there was never any documentation included, just a mystery to solve.

While the PC mainstream has shifted to graphically oriented games, such as those published by Sierra On-Line, the spirit of the original *Adventure* lives on at CompuServe and Genie. The two leading on-line services both offer classic text-only adventure games with the added twist of allowing lots of players to inhabit the game universe at one

time. Now, when you find yourself standing at the end of that road, you may be among a crowd of other players.

While both on-line services offer a variety of games, the flagship programs are Genie's *Gemstone III* and CompuServe's *British Legends*. Developed by the Simutronics Corp. and Muse (U.K.) Ltd., respectively, these games differ from most in that the program's software does not reside in the PC, but rather on the on-line service's mainframe. This nicely settles any copy protection issues.

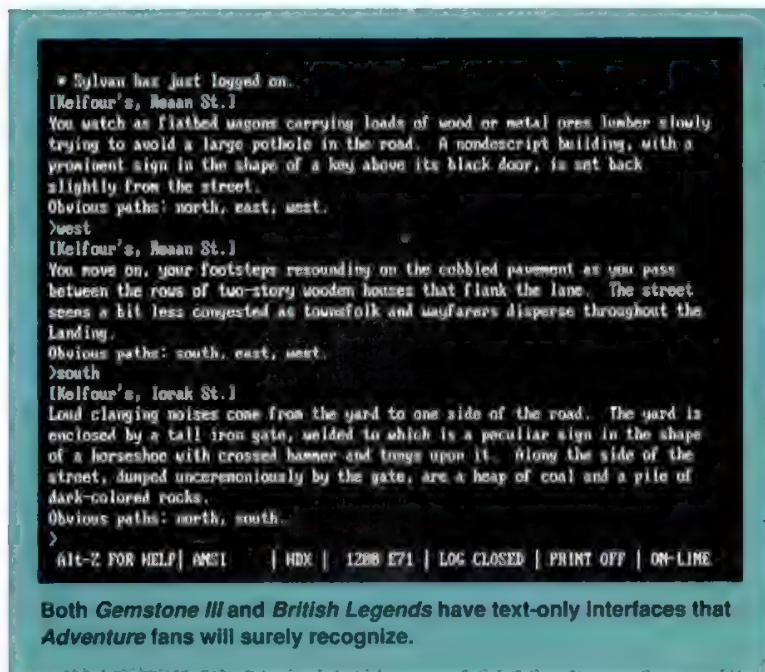
The hardware requirements are

simple: just use your favorite terminal software to dial up the service as usual, select the ser-

vice's gaming areas, and you're set. However, I would recommend using a terminal program with a "chat" mode to prevent the game's output from interrupting your input on the screen.

Both games share the basic

CONTINUES



Both *Gemstone III* and *British Legends* have text-only interfaces that *Adventure* fans will surely recognize.

After Hours

On-line

CONTINUED

adventure plot: You're in a mythical universe reminiscent of Arthurian legend. The universe is full of wizards, dragons, and other magical characters. You move from scene to scene by issuing commands like "go east" or "enter cave." Along the way, you encounter various treasures such as keys with which to open doors or torches that cast light into dark places.

Picking up these objects earns you points and helps you to solve the puzzles encountered all over the games' alternative universe. As you score more points, both *Gemstone* and *British Legends* elevate your character to higher levels of consciousness and skill, finally allowing you to play the game as a kind of wizard overseer, manipulating things from behind the scenes.

While the games are based on similar premises, *Gemstone III* is by far the more intense of the two. *British Legends* allows you to simply choose a name for your character and begin playing the game, for example, but *Gemstone* has tougher entrance requirements.

You're required to choose a number of personality charac-

teristics, including occupation, race, and so on, right down to the color of your eyes. In fact, the sheer number of options involved in getting started can be so intimidating that a simplified setup process is also provided.

The philosophical differences between the games carry through to the instructions. The manual for *British Legends* is a breezy nine pages long, while, at nearly 25,000 words, the *Gemstone* manual is about half the size of an average novel. Genie should make it available in a compressed format. If you're serious about playing *Gemstone*, you'll have to print the manual, since there's no help available while you're playing the game. The kinder, gentler *British Legends* makes a quick command summary available, along with some rather general hints.

Anyone with a passing acquaintance with adventure games will feel at home with either *British Legends* or *Gemstone*. While neither game's command interpreter can be considered a big improvement over the original 15-year-old game, both understand a wide enough vocabulary to make them easy to communicate with.

The main twist on the original game is sharing the universe with other players. When I signed on at peak times, there were as many as 50 other players sharing

Rather than provide elaborate graphics, *Gemstone* and *British Legends* rely on the player's imagination to supply images.

Origin of version: 11:24:34.

Your last game was today at 11:26:27.

Hello again, Jonathan

Elizabethan tavern.

This cozy, Tudor room is where all British Legends adventures start. Its exposed oak beams and soft, velvet-covered furnishings provide it with the ideal atmosphere in which to relax before venturing out into that strange, timeless realm. A sense of decency and decorum prevails, and a feeling of kinship with those who, like you, seek their destiny in The Land. There are exits in all directions, each of which leads into a wondrous, magical mist of obvious teleportation properties...

Alt-Z FOR HELP | FMS | FDX | 1200 EPI | LOG CLOSED | PRINT OFF | ON LI

each game. Even at the slowest times, there were seldom fewer than 10 players. While the manuals of both games mention forming teams and roaming together, I saw relatively little of that. Most characters in both games even seemed reluctant to put up with the mechanics of conversation, which can be slow.

SHARING YOUR SPACE

Having other players share your universe can be a problem, since they can pick the scenes clean of the treasures that are needed in order to score points. To keep the play moving, both games provide for periodic restocking of important objects. In addition, some of the other characters can steal your treasures or attack you, although neither game seemed to reward aggressive play, at least on a newcomer's part. I lost every single fight that I picked with other players.

Both of these games offer a lot of interesting puzzles for the veteran gamer, and the challenge of having other players help or hinder you can add to the excitement. Of the two games, *Gemstone* is the one for people who want to escape reality and really get into playing a role in an incredibly complex world. In my roamings through *Gemstone*, I never saw the same place twice. Drawing a map is definitely necessary to navi-

gate effectively. (As any gamer worth his salt will tell you, the need for mapping tends to separate the serious player from the once-in-a-while dabbler.)

British Legends is better suited to the occasional user, with its simpler entrance requirements and a universe small enough to enable most players to get around adequately by memory.

It's interesting to note that aside from allowing multiple players, neither of these games offers any basic playing improvements over *Adventure*, which certainly validates that early effort. Balancing this lack of pioneering effort is a purchase price that can't be beat. However, you do have to keep in mind that all the time you're playing, the clock is ticking. Connect charges can add up quickly. You may want to play at 300 bps to save money. This slows the games down, but if you're going to put in long hours, slow and steady may be the way to go.

List Price: *British Legends*, 1,200 or 2,400 bps, \$12.80/hr; 300 bps, \$6.30/hr. **Requires:** CompuServe subscription, modem, communications software. CompuServe Inc., Customer Service, P.O. Box 20212, Columbus, OH 43220; (800) 848-8199.

CIRCLE 404 ON READER SERVICE CARD

List Price: *Gemstone III*, 2,400 bps off-peak, \$10/hr; 1,200 bps off-peak, \$6/hr; 300 bps off-peak, \$5/hr. Peak hours (Monday through Friday, 8 A.M. to 6 P.M.), \$18/hr at any speed. **Requires:** Genie subscription, modem, communications software. Genie, 401 N. Washington St., Rockville, MD 20850; (800) 638-9636.

CIRCLE 405 ON READER SERVICE CARD

You are standing in front of a ranchlike hut. Behind you is a field of gorse. Further on to the south you can see a fast flowing river. To the east you can see a range of mountains wreathed in mist and to the west is a small cottage. It is raining.

*exits:

A sleek, black cat sits here, purring happily to itself.
in Woodsman's hut.
south Woodsman's hut.
out Gorse.
north Gorse.
northwest Gorse.
west East pasture.
southwest East pasture.
east Forest near mountains.
northeast Forest near mountains.
southeast Cave.
swamp Rapids.

*get cat
Cat taken.

Alt-Z FOR HELP | U7102 | FDX | 1200 EPI | LOG CLOSED | PRINT OFF | ON-LINE

CompuServe's *British Legends* is a good choice for the casual gamer; it is less complex than Genie's *Gemstone III*.

IN A WORLD WHERE YOU'RE LIKELY TO FIND AN OPPORTUNITY IN EVERY CORNER, PERHAPS IT'S TIME TO FIGURE OUT WHICH CORNERS ARE BETTER THAN OTHERS.

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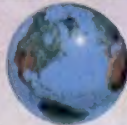
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by
Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing



CARTOON: RICHARD TENNANT

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—Metal Finishing, February 1990

IBM, Siemens team up to make 64K DRAMS

NEW YORK (AP) — IBM and Siemens AG, the German electronics giant, today

will take place at IBM's East Fishkill, N.Y., semiconductor center.

This story talks about a joint venture to develop 64 megabit (not kilobit) chips.

—San Jose (Calif.) Mercury News, January 24, 1990

***TPD is a TLA (Three Letter Acronym) for Two Page Display. DTP is what you do all day. And most nights VGA stands for Video Graphics Adaptor the PC standard. PC/AT is your computer, but you probably already knew that.**

And NVA stands for Not Very Accurate: VGA actually is a TLA for Video Graphics Array, not Adapter. But the creators of this Radius TPD ad probably didn't already know that.

—Radius Inc. advertisement

The United States Playing Card Company

"We Have Nothing To Fear But Fear Itself..."
Winston Churchill

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PC-BASED 1-2-3 TO COME — Lotus Development Corp. recently unveiled a Sun Microsystems Inc. workstation version of its 1-2-3 spreadsheet package. A VAX/VMS version PC-based package is expected to be available by the end of t

Until the January 22, 1990, issue of *Digital News* arrived, we thought Lotus had been shipping 1-2-3 for PCs for nearly a decade.

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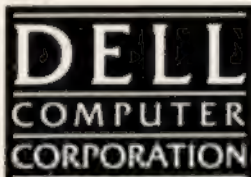
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